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Ontario

Economic and Market Assessment of the Ontario Air Pollution Prevention and Control Industry

September 1999

ONTARIO'S GREEN INDUSTRY

Economic and Market Assessment of the Ontario Air Pollution Prevention and Control Industry

A Sector Study for the Ontario Ministry of the Environment

Prepared by:
The Delphi Group in partnership with
Cleghorn & Associates Ltd. and contributions from
Cullbridge Marketing and Communications

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ONTARIO'S ENVIRONMENT INDUSTRY SECTOR

Ontario currently has more than 2,000 companies that constitute its environmental industry. Ontario's environmental industry companies have developed leading-edge technologies to provide solutions to problems involving the use of air, land, water and energy.

Companies in Ontario's environment industry offer products, processes, or services which prevent pollution, protect or clean up the environment. Companies in this sector offer expertise in the areas of:

- Water and wastewater treatment/water conservation
- Solid and hazardous waste/recycling
- Site remediation and reclamation
- Energy conservation/renewables
- Air pollution control
- Monitoring/instrumentation/labs

As part of its ongoing initiative to provide information on market trends in the environment industry sector, the Ministry of the Environment commissioned The Delphi Group to conduct an economic and market assessment of Ontario's air pollution prevention and control subsector in 1998. The study identified how a number of key market trends will impact Ontario's air pollution prevention and control companies to successfully compete in domestic and international markets, and strategies for handling a shift in the composition of this environment industry subsector (i.e., consolidation, mergers).

We welcome your feedback on the report, and invite you to complete and return the Reader Response Form which you will find on the last page of this document.

ACKNOWLEDGEMENT

This project was directed by a sector advisory committee comprised of the following members:

- Paul Complin, Conor Pacific
- Dr. Georgette Andrawes, Turbotak Technologies
- Robert Fraser, Engine Control Systems
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DISCLAIMER

The views and ideas expressed in this report do not necessarily reflect the position or policies of the Government of Ontario (Ministry of the Environment), nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

The Ministry of the Environment does not assure or guarantee the accuracy or completeness of the information contained in this report.

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"E" List of Industry Associations Consulted
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Glossary

ADB	Asian Development Bank
APPC	Air Pollution Prevention and Control
BACT	Best Available Control Technology
CAT	Canadian Air Technology
CEA	Canadian Electricity Association
CEC	Commission for Environmental Cooperation
CEIA	Canadian Environment Industry Association
CCME	Canadian Council of Ministers of the Environment
CCPA	Canadian Chemical Producers Association
CFCs	Chlorofluorocarbons
CIDA	Canadian International Development Agency
COP	Conference of the Parties
DFAIT	Department of Foreign Affairs & International Trade
EBC	Environmental Business Canada
EBJ	Environmental Business Journal
EBI	Environmental Business International
EBRD	European Bank for Reconstruction and Development
EPA	Environmental Protection Agency
EU	European Union
FGD	Flue Gas Desulphurization
GHG	Greenhouse Gases
GIO	Green Industry Office
HVAC	Heating, Ventilation, Air Conditioning
IADB	Inter-American Development Bank
IAQ	Indoor Air Quality
IEMI	International Environmental Management Initiative
IFIs	International Financial Institutions
IRAP	Industrial Research Assistance Program
LCA	Life Cycle Analysis
MOE	Ministry of the Environment (Ontario)
MOU	Memorandum of Understanding
MVMA	Motor Vehicle Manufactures Association
NA	North America
NAFTA	North American Free Trade Agreement
OCETA	Ontario Centre for Environmental Technology Advancement
NRCan	National Research Council of Canada
PM	Particulate Matter
PEMD	Program for Export Market Development
SMEs	Small and Medium-Sized Enterprises
TPC	Technology Partnerships Canada
TTC	Toronto Transit Commission
UEM	Urban Environmental Management
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
VOC	Volatile Organic Compounds

I. Executive Summary

1.1 Study Overview & Objectives

Air pollution prevention and control markets in Canada and abroad represent a fertile area of business opportunity for Ontario's environment industry. The air market demand, supply and technological forces are in rapid flux and impact directly on the current and future competitiveness of Ontario's air pollution companies.

This study is a comprehensive investigation into global air pollution prevention and control markets with a particular emphasis on domestic and US markets. The study was a complex undertaking. It involved an examination and assessment of the technology, market and business fundamentals for a key business sub-sector of the environment industry.

The study was commissioned Spring '98 by the Green Industry Office, Ontario Ministry of the Environment (MOE), and is timely and germane to the growth and future competitiveness of Ontario air pollution companies. It is also critical to public environment and energy policy in areas such as economic and environmental impacts and opportunities.

The *Objectives* of the Study were to:

- Provide an extensive assessment of Ontario's air pollution prevention and control market;
- Identify the opportunities for growth in niche markets;
- Analyze the impact of global market forces; and
- Provide valuable market intelligence to help companies improve their domestic and export market strategies.

The Study has been prepared by a consortium of three companies led by The Delphi Group, and including Cleghorn and Associates, and Cullbridge Marketing and Communications.

1.2 Study Methodology

Conducting a comprehensive market assessment of the Air Pollution Prevention and Control sector is a challenging proposition. The sector is quite diverse in terms of products and services, technology development, industrial clients and geographic markets.

In recognition of this challenge, The Delphi Group and its partners utilized a number of market research and analysis methodologies to produce this report. The methodologies included the following.

1. *An Exhaustive Review of Market Intelligence Regarding the Global and Canadian Air Pollution Sectors.* A list of Documents and References is provided under Appendix "A".

2. *A Supply-side Market Survey of Ontario Air Pollution Companies.* A total of 42 Ontario air pollution prevention and control (APPC) companies were identified and approached for the supply-side survey; 26 of these firms submitted completed questionnaires. Furthermore, in most cases the consultant spoke with responding companies via telephone to clarify answers to the questionnaire, or to obtain additional information. A copy of the Supply-Side Questionnaire is provided under Appendix "B" and a list of responding companies is found under Appendix "D".

3. *A Demand-side Survey of Major Domestic Purchasers of Air Pollution Goods and Services.* Some 10 demand side companies responded to the survey (16 were approached) from a number of different industrial sectors. In every instance, demand respondents were also interviewed to obtain more information on air markets. A list of responding companies is provided under Appendix "E", and a copy of the demand survey instrument is found under Appendix "C".

4. *Consultations with Various Industry Associations.* The consulting team spoke with seven industry associations to gather sectoral market intelligence on air pollution prevention and control demand drivers and factors.

5. *Analysis of Data and Information to Determine Market Trends and Activity, and to Identify Competitive Issues and Opportunities for Ontario Environmental Companies.* While the data gathering aspects of the study were time consuming, an enormous amount of time and effort went into the final value-added analysis element of the project. The lengthy documents and reference list alone required 2-3 weeks of review and analysis. All this, in the view of The Delphi Group and its partners has produced a comprehensive, current, Ontario-focused examination of the air pollution prevention and control markets in Canada and globally. The report provides a foundation for the development of provincial strategies in this area.

The specific inclusions and exclusions of the report should be noted. The primary focus is on air pollution control markets. While the report pays some attention to process technologies which prevent or reduce air pollution, there needs to be further study on the pollution prevention and greenhouse gas reduction technologies of this subsector.

Through the project, The Delphi Group and its partners were guided by the Air Sector Advisory Group under the coordination of the Green Industry Office.

1.3 Organization of the Report

The report is organized in the following fashion.

- Section II defines the air pollution prevention and control sub-sector, describes its composition and activity, and summarizes the demand and competitive conditions it faces.

- Section III explores the public policy issues arising from the air pollution prevention and control sub-sector in Ontario.

- Section IV looks into the future, providing an overview of demand drivers and forces and makes projections of the makeup of demand in both the short term and into the 21st century.

- Section V advances a range of strategies to enhance the competitiveness of Ontario air pollution companies to proactively seize market opportunities identified in the analytical sections of the report.

In terms of presentation and review of the report an important point should be made. In Sections II-IV a great deal of analytical information is presented. In many instances, the reader will come to ask themselves the question: "Useful analysis, how can, or should, this information be used to improve the competitiveness of Ontario air companies? The report seeks to answer such questions in Section V which provides some prescriptive options for Ontario APPC Companies.

1.4 Strength, Weakness, Opportunities, Threats (SWOT), Major Findings & Strategic Options

A review and analysis of market intelligence on air pollution prevention and control markets and technologies allowed the consulting team to make an overall SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the sector, and reach a group of Top Ten Major Findings.

1.4.1 Strengths, Weaknesses Opportunities, Threats (SWOT)

Below is a summary of the sector's strengths, weaknesses, opportunities and threats that are identified in various sections of the report.

Schematic 1

Ontario Air Pollution Control and Prevention Sector

Summary of Strengths, Weaknesses, Opportunities & Threats (SWOT).

1.4.2 Major Findings

The report makes a range of findings about Air Pollution Prevention and Control (APPC) markets, business opportunities, and the competitiveness of Ontario companies. The major, or Top Nine Findings follow.

Finding #1: Major Economic Contribution from the APPC Sub-Sector

Ontario's APPC contributes significantly to the province's economy. The sector earns annual revenues of $823 million which, on a multiplier basis, has a total impact of $1,070 million on the province's economy. This translates into an overall impact of 8,505 full time equivalent jobs in Ontario.

The sub-sector is anchored around 40-60 firms. Companies are active in all facets of the market including: monitoring /analytical goods and services, manufacturers/distributors of products and consulting/engineering services.

Finding #2: Market Growth and Drivers

A number of factors are converging to drive the domestic and global APPC markets towards a period of sustained, above average growth. Markets are projected to grow at a rate of 6% domestically, and more than 10% globally on an annual basis over the next three years. This growth trend will likely moderate beyond this period, but will continue to be above average for environmental markets. The share of this overall market that Canadian/Ontario APPC companies will garner was not possible to estimate.

Finding #3: Differences in Supply & Demand Market Perception

There is a marked difference in the perception supply and demand side companies have with respect to the influences on the APPC market, and the factors that are important to purchasing decisions. Supply companies have different perceptions than the corporations they serve. This is of concern since supply side companies may be presenting domestic buyers with products and services which do not meet the current and near term future needs.

Finding #4: Lack of Appreciation for Ontario Air Technologies

It was startling that domestic industrial buyers had virtually no appreciation for the current and upcoming technologies Ontario APPC firms had to offer. Bridging this "gap" is an important strategic objective for the sub-sector.

Finding #5: The Market Multiplier of Climate Change

Climate Change, and global efforts to reduce Greenhouse Gases (GHG) emissions will add a new and major dimension to air market demand. Climate Change will, simply, result in more demand (which will lead to higher prices) for technologies which reduce GHG at the same as preventing or controlling air emissions.

Finding #6: The Primacy of APPC Technologies

Air pollution prevention and control technology will be the primary defining basis of competitive advantage in the sector, both within Canada and in global markets. Air pollution services are already, and will be increasingly, less important as a basis for securing business from private and public customers. Given the prospects, attracting capital investment into sub-sector companies for technology R&D and commercialization is critically important.

Finding #7: The Export Orientation of Sub-Sector Companies

Ontario's APPC companies are active exporters. Over 92% of companies surveyed are selling products and services abroad. This said, most exporting companies are heavily reliant on aid-based financing, and tend to approach exports on an opportunistic basis. There are, though, a few successful companies which have taken a strategic, business-oriented approach to penetrating export markets.

Finding #8: The Search for Value-Added Personnel

There is good human resources strength in the sub-sector, however, it is insufficient for sectoral growth. Companies are seeking experienced, value-adding personnel in technology innovation, business planning, marketing and export markets knowledge.

Finding #9: The Partnership Opportunity for Government &Ontario's APPC Sub-Sector

There is a solid partnership foundation on which to build strategies to increase domestic and global revenues of Ontario air companies. The shared leadership, and collaborative approach, of the Green Industry Office, Canadian Environment Industry Association (CEIA - Ontario), Air and Waste Management Association (AWMA), and air companies themselves bodes well for effective strategy development and implementation.

1.4.3 Strategic Options

In Section V of this report, a number of Strategic Options have been developed by the Project Team which, if carried out by the noted key stakeholders, will assist the Ontario APPC industry grow. A summary of these Strategic Options is presented on Schematic 2.

Schematic 2

Air Pollution Prevention & Control

Strategic Framework to Leverage Business Opportunities

Business Opportunities	Potential Business Strategies			
Technology Development	Obtaining Capital for R&D	Human Resource Development	Focusing on Technologies for Key Opportunities	
Bridging the Buyer / Supplier "Gap"	Technology Profiling	Human Resource Development	Understanding Purchasing Decisions	
Enhancing Competitiveness	Import Substitution	Price Down Quality Up	Investment Climate and Research Infrastructure	
Focusing Exports	An Americas Axis*	Proactive Export Strategies	Strategic Alliances and Partnerships	
Targeting Growth Markets	Solutions to Climate Change	Human Health Market	Pollution Prevention Opportunities	Hi-tech Air Pollution: Measurement & Monitoring

* *Latin America, North America, South America*
Source: The Delphi Group, MOE Air Study 1998

II. Overview of Ontario's Air Pollution Prevention and Control Sub-Sector

2.1 The Air Pollution Prevention & Control Sub-Sector

The air pollution prevention and control sub-sector is diverse, complex and subject to a wide range of market forces. Indeed, the sub-sector is comprised of a number of segments some of which are inter-related, and others that are quite distinct.

The essential basis of the air pollution control sector are products and services that remove pollutants from a gaseous stream, or convert pollutants to a non-polluting or less polluting form, before their release into the atmosphere. The sector includes: equipment to control emissions from both fixed and mobile sources, consulting and engineering services related to testing, permitting, preparing specifications, process engineering and implementation of APPC solutions, and engineering and construction of units to house major APPC systems *(Source: US Industry and Trade Outlook 1998. Environmental Technologies).*

The pollution prevention component of this subsector would include technologies, consulting services and re-design of processes to prevent pollution from being created at source.

The air pollution prevention and control sub-sector is composed of four major market segments each of which are common to one or more specific sectors, or types of applications. These major market segments are as follows.

1. ***Emission Monitoring Technologies:*** Technologies for detecting, monitoring, and analyzing emissions.
2. ***Manufacturing of Emission Control and Prevention Technologies:*** Technologies that prevent and control emissions from existing products and processes either as retrofits, process adaptations or the recovery of emissions.
3. ***Providers of Clean Air Technology Services:*** Monitoring, auditing, engineering and analytical services; environmental management and planning; engineering design; land use and/or ecological planning; software development and implementation services; contract research and development; and training.
4. ***Manufacturer/Distributor of Indoor Air Quality Products or Equipment:*** Technologies which control or improve indoor air quality.
   (Source: Industry Canada and Foreign Affairs & International Trade, 1994. A Study of the Clear Air Technology Sector in Canada. 10019/GS/kc, November 1994. KPMG and Cleghorn and Associates).

Surveys of 29 Ontario-based companies from 1994-1996 indicated that the majority of companies offering consulting services in the air sub-sector were multi-disciplinary, providing solutions for both external as well as indoor air pollution problems, and offering *turn-key* control solutions to their clients. These companies formed the core group in the air pollution prevention field in Ontario, offering solutions that covered process modification and substitution, *end-of-pipe* controls and integrated control systems. In addition, many equipment manufacturers offered not only consulting services for the purchased equipment, but also air consulting services as part of their overall sales package. *(Source: Foreign Affairs & International Trade, 1994-1996. Investment and Partnership Opportunities for Canada's CAT Sector in Europe, 1994, 1995 & 1996. Cleghorn & Associates)*

The survey responses from 29 Ontario air companies provided the distribution by activity illustrated in Table 1. Manufacturers of building products and firms providing construction services were excluded from the survey (copy of survey in Appendix B).

Table 1
Distribution by Activity of Ontario Air Pollution Prevention & Control Companies (1994 - 1996)

ACTIVITY	NUMBER OF ACTIVE COMPANIES
Consulting Services	11
Monitoring and Laboratory Services	17
Monitoring, Control and Prevention Equipment	18

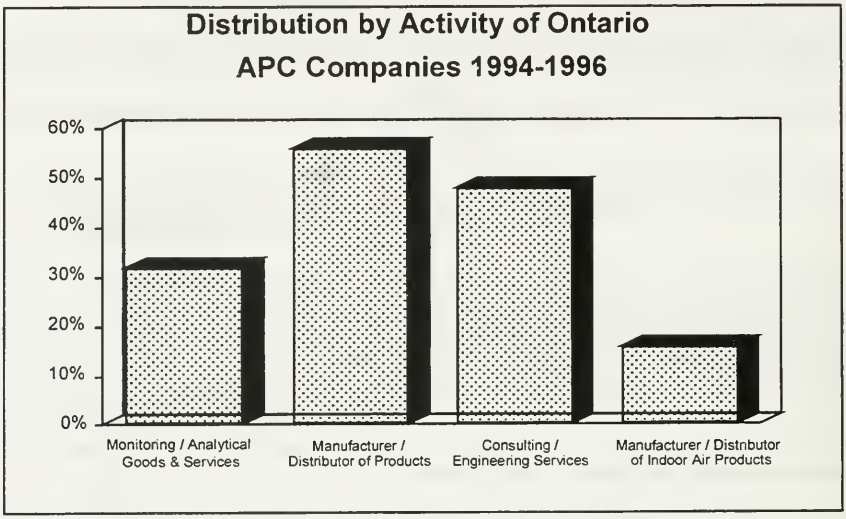
The above results were supported by the Supply-Side Survey associated with this report. The chart on the next page highlights the following facts:

1. Of the 26 responding companies, most are active in more than one category of APPC markets (i.e. monitoring and analysis, manufacturer/distributor, outdoor air products, consulting/ engineering, manufacturer/distributor indoor air quality products).

2. The category which has the highest level of activity (58% of responding companies) is manufacturer/ distributor of air products (outdoor air quality), consulting/engineering services follows closely with 48%.

3. Some 34% of responding companies sell monitoring and analysis services, and a modest number (18%) are active in the manufacture of indoor air quality products.

Chart 1



Source: Supply-Side Survey, MOE Air Study, 1998

The major pollutants or factors that air pollution goods and services prevent or control include the following:

- Hydrocarbons
- Organic Acids
- Suphur Dioxide
- Airborne Toxics
- Stratospheric Ozone
- Particulate Fluorides
- Smog Precursors (nitrogen oxides and VOCs)
- Chlorofluorocarbons (CFCs)
- Chlorine-based compounds
- Fluorine-based compounds
- Volatile Organic Carbons (VOCs)
- Dust and Odorous gases
- Heavy Metals
- Polycyclic Aromatic Hydrocarbons (PAHs)

An illustrative definition of the air pollution prevention and control sub-sector follows.

Table 2
Air Pollution Prevention & Control Subsector

Market Definition

Market Segment	Market Applications								
	Combustion	Transport	Metals	Facilities	Chemicals	Coatings	Wastes	Forest Products	IAQ*
Emissions Control Technologies	Preventing & Controlling Emissions of:								
Emissions Monitoring Technologies	Hydrocarbons Sulfur Dioxide Stratospheric Ozone CFCs Particulate Fluorides Dust & Odorous Gases PAHs Smog Precursors					Organic Acids Organic Compounds Particulates Fluorides Chlorine Compounds Carbon Compound Dust & Odorous Gases Fluorine Compounds Heavy Metals			
Emissions Prevention Technologies									
Providers of Clean Air Technology Services									

* *IAQ - Indoor Air Quality*

2.2 Composition of Ontario's Air Pollution Sector

2.2.1 Overall Scale of the Ontario Air Pollution Sector

Industry Canada and the Canadian Environmental Industry Association have estimated that the total number of Canadian companies in the environmental sector is 4,500. It is accepted that approximately 50% of the industry is based in Ontario, a figure that is supported by the 1995 Statistics Canada environment industry survey. The 1997 Ontario Centre for Environmental Technology Advancement (OCETA), Ontario Environmental Industry Survey estimated that 6% of environmental companies in the province were primarily serving air pollution demand.

Based on these market estimates, the number of companies in the Ontario air pollution prevention and control sub-sector is estimated at 135 (6% of 50% of 4500). Of these, many would be Small and Medium-Sized Enterprises (SMEs), as all Canadian environment industry surveys have noted.

2.2.2 Domestic Versus Foreign Ownership

Preliminary data suggested that extensive re-organization and re-positioning within the environmental-sector in North America is underway, with many of the Small to Medium sized US establishments entering into joint ventures, partnerships or purchase acquisitions with Canadian companies. This trend is particularly true for Ontario-based manufacturers of leading-edge, "niche" air pollution control technologies, such as Engine Control Systems Ltd., or companies that service key municipal sectors such as Gore & Storrie Ltd.

This trend is also observed among Canadian-owned companies. Examples include the acquisition by the Vancouver-based, Conor Pacific Environmental Technologies Inc. of Bovar Environmental and the Wastewater Technology Centre, the acquisition by Philip Services Corp. of Zenon Laboratories, the expansion of national coverage for laboratory services provided by Maxxam Analytics through the partnership of Novamann and Chemex Laboratories, and the acquisition of Kilborn by SNC/Lavalin.

2.2.3 Geographical Distribution within Ontario and Canada

A survey was conducted of 30 representative CAT (Canadian Air Technology) companies in Canada in 1994. The results showed their distribution to be the following *(Source: Industry Canada and Foreign Affairs & International Trade, 1994. A Study of the Clear Air Technology Sector in Canada, 1994. KPMG and Cleghorn and Associates.).*

Table 3
Geographical Distribution of Canadian CAT Companies

CANADIAN TECHNOLOGY COMPANIES	
Location	**Number of Companies**
Atlantic	1
Quebec	5
Ontario	16
Prairies	6
British Columbia	2

Source: Industry Canada & Foreign Affairs & International Trade, 1994.

Surveys of 29 Ontario-based air pollution prevention and control companies, considered to be at least 30 percent of the total population and therefore representative of the sub-sector, showed a distribution for head office location across the province as follows:

- Greater Toronto Area: 21
- South Western Ontario: 6
- Eastern Ontario: 2

(Source: Foreign Affairs & International Trade, 1994-1996. Investment and Partnership Opportunities for Canada's CAT Sector in Europe, 1994, 1995 & 1996. Cleghorn & Associates)

Combining the data from the 2 studies, it appears likely that across Canada, there are comparatively greater numbers of CAT companies clustered in the province of Ontario and that the nodes of activity are in the GTA and, to a lesser extent, in South Western Ontario.

This can be explained by the fact that Ontario's petrochemical industry is concentrated in this area and the MOE has established a regulation to control air quality from Industrial SO_2 emissions.

2.2.4 Supply Side Activity by Industry Sector

The environmental services industry is concerned with many aspects of air pollution, but the main pollutants include hydrocarbons, organic acids, suphur oxides, particulate matter, including fluorides, chlorofluorocarbons (CFCs) and other ozone depleting substances, chlorine and fluorine-containing compounds, VOCs and nitrogen oxides, heavy metals (e.g. lead, mercury), and airborne toxics (e.g. benzene). Pollution abatement equipment employed to remove these types of pollutants from the air include: filters; collectors; scrubbers; catalytic converters; electronic beams; desuphurizing agents; and oxidizing agents. In general such methods cleaned air either by removing pollutants from a gaseous stream, or by converting pollutants to a less potent form of pollution *(Source: Sawinski, D., Mason, W., editors, Encyclopedia of Global Industries. Air and Water Resources and Solid Waste Management, 1998).*

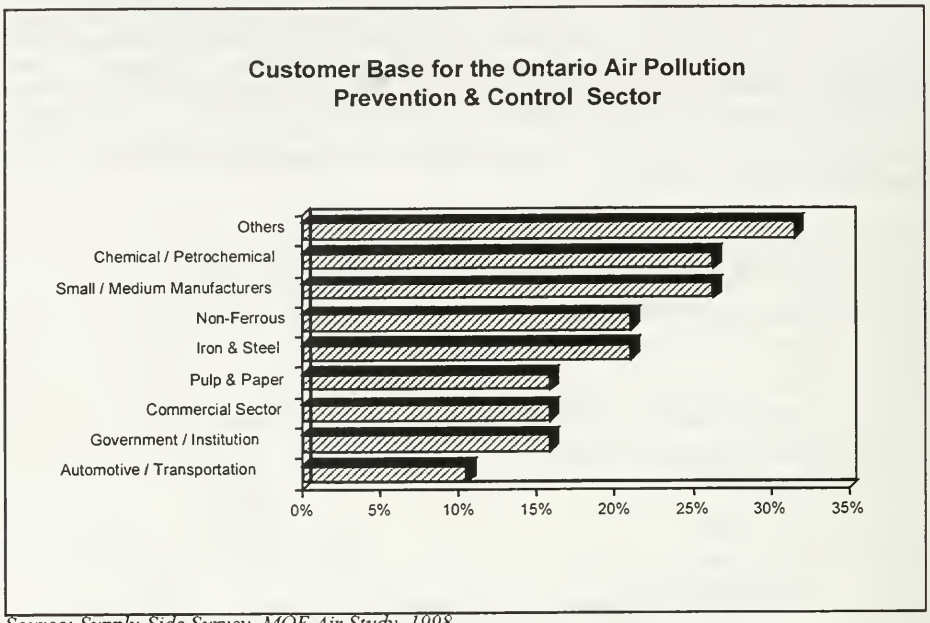
Traditional sectors in Canada that are in demand of air pollution control and prevention technologies include the following:

- Automotive
- Oil and Gas
- Chemicals and Petrochemicals
- Utilities
- Mining
- Non-ferrous Smelting and Fabrications
- Ferrous Smelting and Fabrications
- Pulp & Paper
- Metals Recycling
- Municipalities
- Commercial Buildings.

No detailed survey data were discovered in the literature for sales by Ontario suppliers to technology end-users. It appears that while the products and services from companies such as Engine Control Systems Ltd. are sector specific, or pollutant specific (e.g. Tekran Inc.), the majority of Ontario-based firms offer solutions and products that can be applied to a range of industrial sectors and production processes with gaseous emissions containing a large number of pollutants.

The current Ontario supply-side survey identified the customer base breakdown as portrayed below for Ontario air pollution companies (copy of survey in Appendix B).

Chart 2



Source: Supply-Side Survey, MOE Air Study, 1998

A number of points are pertinent to Chart 2.

- Generally, the majority of companies serviced a number of industrial sectors.
- Only three companies focused their services in one industrial sector.
- A total of 13 companies indicated that more than 50% of their customers resided in one major sector.
- At least one surveyed air company served each of the identified industry sectors.
- The large "Other" category reflects a number of industrial sectors which were only served by 1 or 2 air companies. These sectors included: food processing, utilities, mining, oil and gas, and metals recycling.

2.3 Existing Business Activity

2.3.1 Products and Services Activity

The 1994 KPMG study provided the data in Table 4 illustrating the average CAT sales for Canadian companies as a function of the number of employees engaged in that activity. It is argued that since over 50 percent of the companies surveyed were from Ontario, the data may be considered representative for that province *(Source: Industry Canada and Foreign Affairs & International Trade, 1994. A Study of the Clear Air Technology Sector in Canada. 10019/GS/kc, November 1994. KPMG and Cleghorn and Associates).*

Table 4
Average CAT Sales and Number of Employees

Number of Employees	Average CAT Sales ($ million)
1-19	$0.9
20-39	$2.2
40-74	$5.3
75+	$5.3

There appears to be a fair distribution in terms of revenue generated by Ontario air companies from the sale of products and services. There also appears to be a pattern of distribution related to size of the company.

The current supply-side survey showed that:

- 38% (10) of the responding firms receive 75% or more of their revenue from the sale of products. Of these, the majority had less than 50 staff. Only 2 companies had between 51 and 100 employees.
- 27% (7) obtain 90% or more of their income from the sale of services. Of these, all but one has 101+ employees. The other firm has between 11-50 employees.
- 23% (6) acquire 80% or more of their revenue from integrated sales and services. Of these, the majority have less than 50 employees. Only two firms have between 50 and 250 staff.
- The remaining 12% receive a mix of revenues from the strict sale of products, services, and integrated products and services.

Source: Supply-Side Survey, MOE Air Study, 1998

2.3.2 Assessment of Market Drivers

Canadian air companies consistently rate strict regulations and enforcement as being of primary importance for the sub-sector. In a 1994 Federal study that canvassed information from suppliers, industry associations, and government and industry professionals knowledgeable in the field, this issue was rated by far the highest in terms of the development of a strong sub-sector. This view was echoed by knowledgeable government and industry professionals in the United States, Germany and Japan in the same study. It is highly probable that this assessment applies to Ontario companies *(Source: Industry, Science & Technology Canada, 1994. Environmental Industries Consulting Study and Needs Profile of Critical Science and Technologies for Canadian Industries and R&D Institutions. Ernst & Young & Concord Environmental).*

With regard to environmental legislation and enforcement, Canada has a similar ranking to Norway, France and the United Kingdom and has a regulatory climate that is comparatively less severe than countries such as Italy, the United States and Germany *(Source: IMD, 1996. World Competitiveness Yearbook, Switzerland, IMD International).* In Canada, Ontario is the leading province with regard to regulating industry and has extensive environmental regulations. In July 1996, the Ministry of the Environment announced it would reform its 80 environmental and energy related regulations.

Based on the study survey of buyers and suppliers, Ontario air companies continue to rate regulations as the primary factor of importance for both the supply and demand of APPC technologies. Responding companies rated future regulations slightly more highly than current legislation. Supply companies also feel their buyers rank employee health issues and voluntary agreement high under purchase criteria. Smog plans and energy forces also rated moderately high. The chart on the next page highlights the views of the suppliers (i.e. Ontario air companies) and buyers surveyed with respect to supply and demand factors impacting the air market.

The chart points to a major divergence of view between supply companies and industry/government buyers in terms of the relative importance of a number of factors affecting purchasing decisions. The difference of view must be better understood with the objective of improving the competitiveness of Ontario air companies.

- In this question on the demand and supply-side surveys, respondents were asked to identify the "Three Most Important" factors which influenced supply and demand.

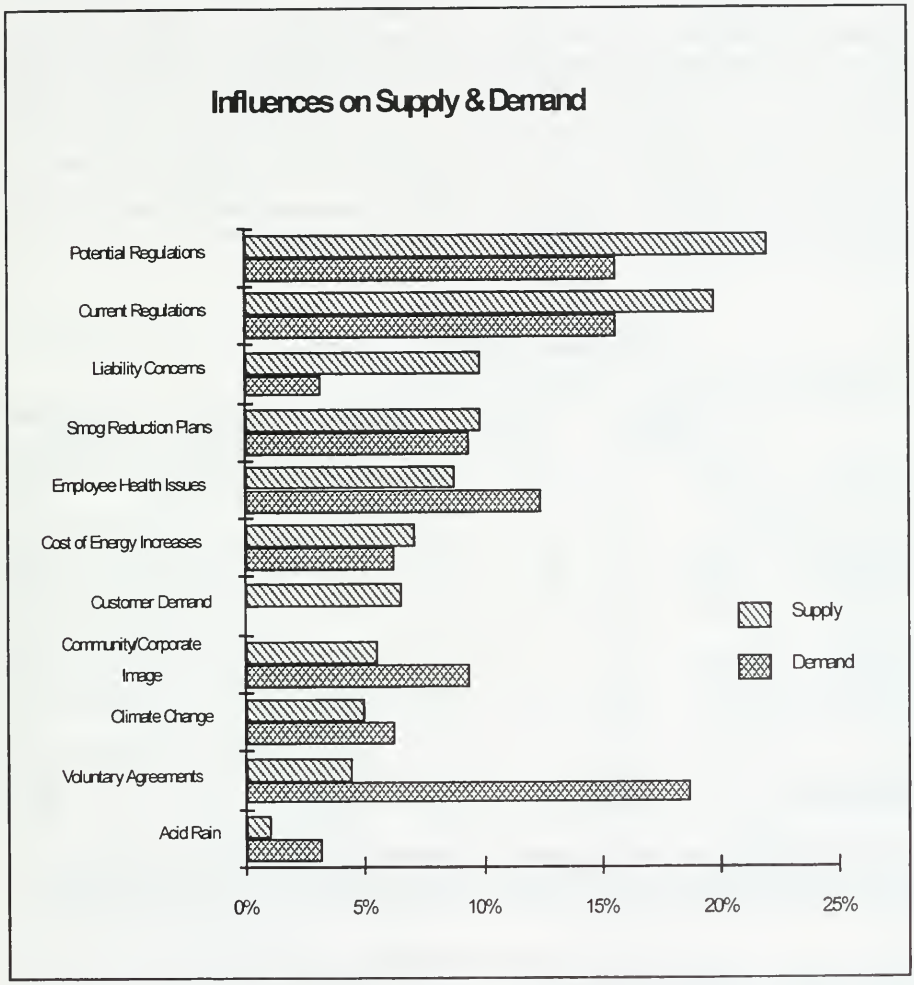
- The most dramatic finding of the combined surveys is that industry buyers of APPC and prevention products and services believe that potential and current regulations are less important to supply and demand than voluntary agreements and actions. Supply companies, in contrast, rank regulations (current or potential) as the most important factor influencing supply and demand, and only in only one instance did an air company even feel that voluntary agreements were important at all.

- In 4% of responses, surveyed buyers said that liability concerns were an issue, however, 10% of suppliers responding to the questionnaire rated this as a "top three" influencing factor.

- Buyers were more concerned about employee health issues, community/corporate image, climate change and acid rain than suppliers, though, the differences were marginal.

In summary, this part of the demand and supply surveys suggests that buyers believe that they have installed, or have access to, the air products/services required for compliance, but are more concerned about factors which "go beyond compliance". Ontario air companies tend to believe that regulatory and liability issues are more important to purchasing decisions than other factors. There is clearly a need for Ontario air companies to better understand the needs of their customers, and the means of doing so are addressed in Section V of this report.

Chart 3



Source: Supply and Demand Side Surveys, MOE Air Study, 1998
Note: Customer Demand Response is not Applicable to Demand-Side Companies

2.3.3 Ontario and Canadian Markets

The 1995 Statistics Canada environment industry survey provides a benchmark of air sub-sector activity. A summary of the survey, particularly as it relates to air markets, is presented in Table 5.

The highlights of this first comprehensive, empirical national accounts survey of Canada's environment industry are listed below. Environmental goods and services provided in Canada in 1995 reached $16.748 billion. This was substantially larger than earlier (not empirical surveys) estimates of $11.0 billion in 1991.
Overall, Canada's trade balance for the sector was better than expected. Imports of environmental goods were less than generally believed. In total, imports accounted for $1.2 billion or 7.2% of total environmental sales in 1995. The disappointing news for the air pollution prevention and control sub-sector is that 82.3% of domestic demand for air pollution control technologies in 1995 was met through imports. Of the $ 1.059 billion spent on air pollution control technology in Canada, only $145 million was provided by Canadian companies. The other $914 million was imported. Industry opinion of these figures is that there has been some underestimation of domestic supply, and overestimation (in relative terms) of imports (for example, analysis of Statistics Canada data shows that the transport-related air emissions control market segment has not been included in this data). While this may indeed be the case, it would likely affect the percentages only marginally.

Table 5
1995 Environment Industry Data

SALES	PRIVATE SECTOR SALES $ million	GOVERNMENT SALES $ million	TOTAL DOMESTIC PRODUCTION $ million	TOTAL IMPORTS $ million	TOTAL DOMESTIC SUPPLY $ million
Producers of environmental equipment	3,653		3,653	1,188	4,841
Air Pollution Control equipment	145	0	145	914	1,059
Environmental Consulting Services	5,032	4,025	9,057	0	9,057
Air Pollution Consulting Services	388	0	388	0	388
Total Environmental Equipment & Services	10,723	4,837	15,560	1,188	16,748

(Note: Table 5 is not a complete reproduction of Statistic Canadaís data; only a selected number of relevant rows and columns of information are included in the above table. Source: Statistics Canada, National Accounts and Environment Division, item 16F0007XIE, June 1997.)

Other air market data generally supports the demand numbers reached by Statistics Canada. The recent Technology Partnerships Canada (TPC) report on environmental markets, prepared by The Delphi Group, presents data for both the Canadian and global air markets. This information is reproduced in Table 6 and includes demand estimates for control of automotive-related emissions.

The general conclusion is that Canadian and Ontario companies in the air pollution sector lack the strength to compete with imports in meeting domestic demand. There appears to be a number of reasons for this competitive weakness. Firstly, offshore firms in the US and Europe have large domestic markets and, therefore, possess greater economies of scale. Secondly, countries such as the US and Germany have a more substantial manufacturing base (relative to Canada's resource-oriented economy) which demands scrubbers, adsorbers and electrostatic precipitators - equipment that comprises a large proportion of the total air market. Thirdly, other economies such as the US have, over the past two decades, tended to "lead the pack" in introducing new air regulations (e.g. West Coast Air Quality Standards) and this has fostered a more substantial supply capacity which is poised to penetrate new markets as specific, more stringent air regulations become the norm.
This said, the amount of air product exports into Ontario suggests that there is an enormous opportunity for import substitution. The extent and nature of the import substitution business opportunity is addressed in later chapters.

Table 6
Canadian & Global Air Pollution Prevention & Control Markets

Market Segments	1996 Revenue ($ Millions)			
	CANADA	Annual Growth to 2000	GLOBAL	Annual Growth to 2000
Particulate Systems				
Fabric Filter Systems &	174	4%	4 037	9%
Electrostatic Precipitators	202	5%	5 602	10%
Gas Treatment Systems				
FGD System &	119	4%	3 864	12%
NOx Control Systems	84	6%	2 346	14%
Scrubber & Adsorber Systems	197	3%	4 960	14%
Thermal Incineration	69	3%	1 863	12%
Transport Related Technologies				
Catalytic Converters	580	6%	6 230	9%
NGV Systems	40	5%	700	7%
Vapour Recovery Units	20	2%	400	13%
Other Air Equipment & Services				
Air Consulting	118	6%	4 002	8%
CEMs & Stack Testing	104	4%	3 174	6%
Indoor Air Technologies	32	7%		
Total Air Markets	1 739	6%	37 178	10.5%

Primary Source: The Delphi Group
Secondary Sources: McIlvaine Company Scrubber/Adsorber Markets

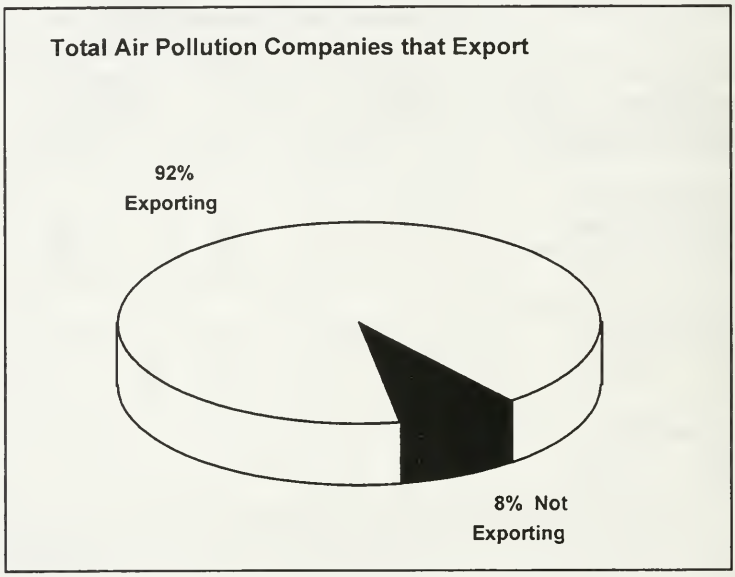
2.3.4 Export Markets

The 1994 Study of the Clean Air Technology Sector in Canada for Industry Canada and DFAIT by KPMG and Cleghorn & Associates found that 24 of the 30 firms surveyed had international sales, and the export market distribution was as follows.

USA	20 firms generating sales
Asia Pacific	11 firms generating sales
Western Europe	10 firms generating sales
Mexico	5 firms generating sales
South America	6 firms generating sales
Central America	3 firms generating sales

The aggressive export orientation of Ontario air companies was also clear in this current study. Almost all surveyed companies (22 of 24 respondents) are currently exporting goods and services outside of Canada. 50% (11) of those indicated that exports currently represent in excess of 50% of their total sales. These are very high export percentages for any industry sector, and markedly so for Canada's environmental industry. This export orientation is displayed in Chart 4.

Chart 4



Source: Supply-Side Survey, MOE Air Study, 1998

There appears to be no identifiable patterns with respect to the type of function performed (manufacturer versus service) and exporting sales.

- Of the 8 manufactures that export outside of North America (NA), 6 have majority sales in Canada.
- 10 of 12 firms who provide consulting and engineering services obtain sales outside of NA (range 5% to 49%).
- With respect to size and export activity a general finding is that the larger the firm the more likely they are to penetrate countries outside of NA. For example:

  3 out of 4 (over 500) export out of NA (7-22%)
  3 out 3 (101 to 250) employees export out NA (10, 16 and 49%)
  2 out 3 (51 - 100 employees) export out of NA (8 and 65%)
  5 out of 7 (11 to 50) export out of NA (5-15%)
  4 out of 7 export out of NA (7-25% of total sales)

2.3.5 Marketing Functions

In the 1994 KPMG study, Canadian suppliers indicated that their marketing strategy in penetrating foreign markets included having local representation, namely agents, distributors and the use of detailed market studies by recognized companies such as Ernst & Young.

Box 1

Ontario Success Stories

Maxxam Analytics (in 1994, then known as Novamann) used the services of a market analysis firm to help them assess the Mexican demand for laboratory services before deciding to enter into a partnership with a Mexican firm. Maxxam is now earning revenue from its Mexican operation.

As another example, companies such as Turbosonic Technologies are placing greater emphasis on this function by appointing full-time sales managers, charged with identifying market opportunities, developing marketing strategies and business plans, closing sales and maintaining customer confidence.

It appears that Ontario air companies are devoting increasing attention to the task of marketing goods and services in both domestic and export markets. Companies are using a range of marketing and distribution systems. Based on the results of the current survey study:

- Only 3 firms do not use in-house sales staff. These 3 companies tend to rely on retail outlets and/or strategic alliances.
- 23% (6) of responding companies utilize in-house staff and strategic alliances only. Of these, 5 have more than 101 employees, and one has less than 10. Of the six firms: 3 are consulting, 2 monitoring, 1 is a manufacturer.
- 15% (4) of respondents use in-house sales people only.
- 31% (8) use in-house sales staff and independent distributors/dealers and/or independent sales agents. All of these companies have less than 50 employees, and 7 do some form of manufacturing.
- 19% (5) utilize in-house sales, strategic alliances, and independent sales agents or distributors. Of these, 4 are manufacturers, and one is a monitoring company.

2.3.6 Export Market Strategies

Over the last six years, there has been a dramatic change in the export strategies being adopted by most major Ontario companies. They are generally more focused in terms of the specific products and services they provide and the markets they target. Many small/medium sized companies, however, do not take a focused approach and often implement strategies that might at best be considered opportunistic. Small and medium sized firms often lack the capacity and investment capital to develop more focused approaches.

In larger competitive terms, it is no longer acceptable to consider project opportunities on an *ad-hoc* basis; developing a 3-5 year game plan is now considered mandatory. However, while there are notable exceptions, not all Ontario air companies have embraced, or are taking, a planned, proactive approach to penetrating export markets. Supply-side consultations found that many companies continue to take an *ad-hoc*, responsive and fragmented approach to exporting. Remedying this is part of the strategic response to competitive market realities which is addressed in Section V of this report.

There are illustrations of how Ontario air companies should approach export markets.

Box 2

Ontario Success Stories

Albarrie Canada, following their participation at the EcoBrasil Trade Fair in 1992, developed a detailed marketing strategy that allowed them to capture a part of the Brazilian market for fabric filters.

Another example would be Senes Consultants who brought in key professionals to enable them to successfully capture and maintain a presence in Vietnam and Trinidad.

The current supply-side survey also showed how Ontario air companies are utilizing various joint venture and strategic alliance linkages for penetration of export markets.

- When entering the international scene, 78% (18 of 23) of respondents currently exporting outside of Canada indicated that they were partnering with other organizations to compete in foreign markets. In all cases, these companies are partnering with a firm(s) located in at least one of the countries in which they are currently exporting. Over 50% indicated that they were partnering specifically with firms located within the country where a tender had originated.

- Only 16% (or 3) of the companies surveyed are partnering with other Ontario firms, and 30% (6) are partnering with other Canadian firms located outside of Ontario.

- All of the four large firms (500+ employees) team up with other companies to compete internationally, and 3 of these firms are partnering with other Canadian companies.

- Only 3 of the 15 smaller companies (less than 50 employees) have teamed up with other Canadian firms.

2.3.7 Sales Transactions

The turmoil surrounding the stability of foreign currencies has led the majority of Ontario firms to quote their prices in United States dollars and use the support or credit lines available through agencies such as the Export Development Council or the Canadian Commercial Corporation.

Several companies were hurt financially as a result of the devaluation of the Mexican peso and the current problems in Indonesia and the Far East have made Ontario firms, such as RWDI Inc. very cautious when contracting services or processing sales of products in countries such as Taiwan.

Ontario air firms appear to follow traditional payment procedures for the sale of both goods and services. Only one firm of those surveyed utilized sales repayment plans over a specific term. All the remaining firms used purchase orders and/or project-based invoices. Relative to the movement to sales financing (especially of goods account), Ontario companies appear to be more conventional and may find competitors offering more preferential sales financing terms to customers, notably with respect to air pollution prevention and control goods.

2.4 Current Demand Forces

2.4.1 Major Market Drivers Common to Most Markets

A number of major air pollution prevention and control market drivers are common to all markets.

- ***Particulates:*** Inhalable and respirable particulate (i.e. particulate matter of 10 microns [PM 10] or 2.5 microns or smaller [PM 2.5]) are of major concern to all markets. As a byproduct of combustion, particulates are considered a major health risk. These compounds are also a major component of smog. The Ontario government's action is illustrative of concern over particulates in all markets. In November 1997, the Minister of the Environment, Norm Sterling, announced an interim standard for PM 10. This standard will be monitored and evaluated soon to determine how it can best reduce smog effects. National standards are being developed for PM 10 and PM 2.5.

- ***Kyoto Climate Change Convention:*** At the December 1997 Climate Change Conference of the Parties (COP) meeting in Kyoto, Canada was one of 159 nations that agreed to establish binding limits for greenhouse gas (GHG) emissions. The Kyoto Protocol adopted proposes to limit overall net GHG emissions from 38 industrialized countries such as Canada during the years 2008-2012. The GHGs covered by the Protocol are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and suphur hexafluoride.

  This binding and rigorous Climate Change agreement will lead to an intensification of effort to reduce greenhouse gas emissions. The scope and magnitude of the Kyoto agreement will likely be felt only once it has been ratified by a minimum number of Annex 1 countries, and most importantly the United States. In all likelihood the Kyoto agreement will become a profound market driver for air pollution prevention and control markets including: greenhouse gas re-capture and neutralization technologies, improved combustion technologies, energy efficiency, and industrial energy eco-efficiency process technologies.

  In effect, GHG reduction is linked to air pollution in two respects. Firstly, in the course of addressing air pollution such as smog and industrial emissions, certain prevention and control technologies/processes also reduce GHG emissions. Thus, under the Kyoto convention they would have an additional higher value to many buyers. Secondly, on the flip side, in the course of reducing GHGs, air quality is improved. In effect, the climate change factor will be a driver for air markets and technologies, and improved air quality, because of linkage between GHG emissions and air pollution.

  The pace of activity that underlines the National Implementation Strategy on Climate Change has been hectic to say the least. Widespread, and intense, consultations have been underway for the last several months in an effort to determine the focus, composition and leadership of more than a dozen primary "Tables" each of which will address a specific climate change issue or subject.

  The final configuration and number of "Tables" at this writing has not been finalized, but is becoming more clear. There is intense discussion about whether certain national "Tables" are required at this time, and if other issues/subjects have been inadequately addressed. In addition, some industry sectors, and even environmental NGOs, have explored the idea of setting up forums which are independent of, but contributory to, the formal national "Tables".

Box 3

National Consultation "Tables"

- Credit for Early Action
- Canadaís National Implementation Strategy on Climate Change
- International Feasibility Mechanisms
- Electricity (including renewables)
- Modeling & Analysis
- Public Education & Outreach
- Transportation (water, air, road, rail)
- Agriculture & Agri-Food
- Forests Sector (including carbon sinks)
- Financial and Economic Instruments
- Technology
- Municipalities
- Enhanced Voluntary Action
- Industry
- Sinks

Note 1: As of June 26, 1998

- ***Health Impacts:*** The International Environmental Monitor of Environics International (formerly Synergistics) has tracked public opinion on the environment, including air issues, for the past five years. A recent survey has shown a marked shift in worldwide concern about the environment. Respondents in 24 countries (including Canada, other industrialized and developing countries) ranked environmental risks to their health, and that of their children, as among the highest priority concerns. In this respect, air pollution has clearly emerged as the highest environmental health risk due to its universal human health impact in a particular bio-system. On average, 94% of respondents perceived that environmental degradation was already harming their health. This finding is not new, however, the high degree of pressing concern about health risks arising from environmental factors is a recent development.

  The balance of research and empirical evidence points to a number of air pollution substances as increasing health risks. These include: fine particulates, ground level ozone and ozone precursors, among others.

  These public concerns about human health risks will affect demand for environmental technologies, particularly air technologies.

- ***The Montreal Protocol:*** The phase-out of certain volatile CFCs such as CFC-11 and 12 as well as the controls applied to other ozone depleting substances such as halon 1211 and 1301 is one of the key issues in dealing with the problem of stratospheric ozone. As in other examples, the public concerns about skin cancer and other human health risks will affect the demand for air pollution prevention and control technologies. It will also play a major role in the design used for ventilation systems for commercial and industrial buildings and heat exchangers in general.

- ***Cross-Border Air Effects:*** The cross-boundary transmission of air pollution is a major issue in North America, Europe and Asia. Climate conditions and proximity of populations and industrial centres leads to the transference of air pollution from one country to another. The Ontario-Great Lakes region is typical of this phenomenon which sees the US industrial heartland emit air-borne pollutants that contribute to a large proportion of southern and eastern Ontario's smog. This situation means that air policy action has a bi-lateral element involving relations between countries. It also tends to create market opportunities across borders within one airshed.

- ***The Role of International Financial Institutions:*** International Financial Institutions (IFIs) such as the World Bank and its agencies, regional development banks (Asian Development Bank [ADB], Inter-American Development Bank [IADB], African Development Bank) are having a profound impact on environmental technology markets. Borrowing requirements from these institutions now carry a number of environmental stipulations which are driving demand for environmental technology. Further, IFIs are also active in actual lending for environmental initiatives.

  1. The World Bank has created a $US 300 million fund for air pollution prevention in India.

  2. The Inter-American Development Bank is financing a number of urban air monitoring projects in Latin and Central America.

  Most of these initiatives encourage private sector driven environmental technology transfer, and lead to the creation of new joint venture relationships between local and offshore firms.

- ***Urban Environmental Markets:*** The term Urban Environmental Management (UEM) is relatively new to the environmental sector and to the management of cities. It has arisen because of a number of factors. First, the increasing importance of large cities, particularly in developing countries, has concentrated concern of environmental problems that occur due to rising urbanization.

  A quote from a new book, jointly published by the World Resources Institute (WRI), The United Nations Environment Programme UNEP), the United Nations Development Programme (UNDP) and the World Bank, illustrates the importance of UEMs.

  > *"..... Urban environmental conditions are important to the health and quality of life of a city's inhabitants and can impose significant costs on economic and social development. The impact of urban areas on the surrounding environment is also an issue of growing concern. More than half of humankind will live in urban areas by the end of the century, and 60 percent by the year 2020. In most nations, cities generate a majority of the economic activity, ultimately consume most of the natural resources, and produce most of the pollution and waste. Thus, urban environmental issues, although often overlooked, are important both locally and on national and global scales ....."*
>
> *"World Resources: 1996-97: The Urban Environment"*

  Urban environmental factors will drive much of the demand for air pollution technologies and services in Asia and Latin America over the next two decades.

2.4.2 Ontario and Canadian Market Drivers

A number of other Canada-wide market demand forces should be noted, most of which also apply to Ontario.

- ***Suphur in Fuel:*** Diesel fuel regulations in Canada are beginning to respond to pressure to lower suphur content to 0.05%. The Federal government has recently announced that the Sulphur limit in gasoline (presently 530 ppm) will be 150 ppm in 2002, and 30 ppm in 2005. *(Source: EM. December 1996. Diesel fuel Regulation Take Effect).*

- ***Boundary Air Transmissions:*** Canada and US agreed to develop a joint action plan for addressing transboundary pollution. Amongst others: coordinating smog reduction, reducing ground level ozone and particulate matter, examine legal issues regarding transboundary air pollution, and creating regional partnerships where it is a problem. The proposed Canadian air quality objective for ground level ozone (O3) is an ambient 8 hour average of 80 ppb (parts per billion), similar to that adopted by the US EPA in July 1997. *(Source: EM. June 1997. Canada and US Aim for Reduction of Air Pollution. p.6.).*

- ***The Ministry is developing new air standards for certain parameters:*** These include: Acetaldehyde; Arsenic; 1,3-Butadiene; Cadmium; Carbon tetrachloride; Carbon monoxide; Chromium VI; Cyclohexane; 1,2-Dichloroethane; 1,4-Dichlorobenzene; Dioxins; Fluorides (HF); Formaldehyde; Heptane; Inhalable particulates: PM10,2.5; Mercury; Methylene chloride; Nickel; Ozone; PAH; Styrene; Tetrachloroethylene; Total reduced sulphur; Trichloroethylene; Uranium.

- ***VOC Protocol:*** Canada has signed an international protocol for Volatile Organic Carbons (VOCs) under the aegis of the United Nations Economic Commission for Europe. Negotiations with the provinces to develop bilateral agreements under the NOx/VOC Management Plan are awaiting acceptance of the pending Comprehensive Federal/Provincial Air Quality Agreement. In the meantime a number of industry sectors have developed voluntary VOC Management Plans, including the metals finishings and surface coatings industries.

- ***Best Available Technology Developments:*** In Alberta, for all point and area sources, such as food processing and sewage treatment plants, as well as other industrial processes that generate VOCs, an approval process is followed, whether it is a "greenfields" operation or a retrofit to an existing plant. To obtain a Certificate of Approval to install and operate, the applicant must show that "Best Available Demonstrated Technology (BADT)" will be installed for emissions control.

  In British Columbia they have guidance policies dating back to the 1970s. Certificates for Approval are based on the applicant's use of Best Available Control Technology (BACT) and it is applied on a case by case basis.

  In Ontario, under regulation 346 of the Environmental Protection Act, the discharge of a contaminant that causes or is likely to cause an adverse effect, is prohibited. An example of an adverse effect that violates section 14 of the Act is an odour which causes a loss of enjoyment of outdoor activities. Certificates of Approval are based on compliance with environmental regulations and, where possible, best available technology economically achievable (BATEA) is the preferred control measure.

- ***West Coast Air Quality Standards:*** Concern over air quality is leading to a West Coast movement towards higher air quality standards and promulgated new legislation which is similar to the more restrictive air measures in California and Oregon. The new BC standards were largely a response to declining air quality in the Lower Mainland, which is projected to worsen as population density rises.

- ***CCME Smog Initiative:*** Each province has the option of developing plans to control smog. The three regional areas most affected by smog which have this process underway are: the Greater Vancouver Regional District, the Windsor-Ontario corridor and the Atlantic region. This initiative has become a major force for environmental technology markets, particularly in Ontario and BC. Examination of the preliminary Ontario Smog Plan suggests that over the medium to long term (i.e. 5-10 years) one can expect it to have a number of impacts on environmental technology markets. Ontario has proposed in its SMOG plan by the year 2015, VOC and NO_X levels should be 45% less than 1990. Ontario is presently working with a wide range of stakeholders that release, or products that release VOC and NO_X to our atmosphere.

  1. Drive Clean, Ontario's vehicle emissions testing program, requires designated vehicles in areas with serious smog problems (Greater Toronto and Hamilton Wentworth region) that are more than 3 years old and less than 20 years old pass a Drive Clean test every two years prior to renewing the license plate sticker. Drive Clean will help reduce smog in Southern Ontario.

  2. Governmental and public pressure will prompt automotive manufacturers to re-focus their efforts on fuel efficiency (which have been remarkably effective over the past two decades).

  3. Alternative fuel and battery technologies will be given a boost through continued (in the case of ethanol) and new tax incentives to the extent that they reduce air pollution.

  4. Industries which generate air emissions can expect to have various restrictions placed on them, for example, mandatory shut-downs days during period of smog crisis. This will increase demand for air pollution prevention and control technologies.

  5. Companies which sell products which produce air emissions (e.g. paints and solvents) will seek out technologies which substitute alternative inputs which are more air-friendly. A good example of the emergence of green procurement practices which is influencing demand in air markets is the approach taken by Chrysler Corporation. Chrysler has over the last two years virtually eliminated the use of oil-based paints and solvents in its own auto finishing processes and those used by its suppliers. This has meant that Chrysler's autoparts suppliers have had to conform with the company's water-based coatings standard which, in turn has had a beneficial effect on the province's environment, notably in terms of release of VOCs.

Other demand factors specific to the Ontario market include the following.

- ***Waste Incineration:*** Ontario municipalities are now allowed to burn municipal sold waste in incinerators. All facilities will be subject to a ministry approval and will be required to meet the performance-based pollution control targets set out under Guideline A-7. *(Source: EM. March 96. Ontario Incineration Guidelines Get Tougher).*

- ***CFC's:*** Ontario banned 1,1,1, the making, use, transfer or discharge of Class 1 CFC's effective July, 1996. A number of class one ozone depleting substance including solvents such as methyl chloroform will be deemed to be hazardous waste pursuant to O.Reg. 717/94 (solvents). *(Source: EM July 1, 1996).*

- ***Ontario Hydro Developments:*** Recent developments in the generation and delivery of energy on the part of Ontario Hydro (Canada's largest utility and largest consumer of fossil fuels) will have a dramatic effect on the demand for environmental technologies in several respects.

  1. Ontario Hydro expenditures on air pollution control devices will increase by 20-30% as it fires up dormant or underutilized fossil fuel generating capacity (e.g. Nanticoke). Ontario Hydro will also seek new technologies which are more cost efficient.

  2. Demand side management efforts (i.e. energy efficiency) on the part of industrial and retail customers will increase because of price increases and utility promotion efforts. This will increase demand for a very wide range of energy efficiency equipment from industrial boilers and dryers to home energy consumption and conservation devices.

  3. There will be a greater push to source competitively renewable energy technologies. These include: wind and solar energy and biomass and micro/mini Hydro.

  4. A greater reliance on fossil fuel generation (likely under any short to medium term scenario) will release greater amounts of NOx, SO_2 and particulates into the atmosphere reducing air quality. General public and governmental concern over the situation, and its impact on human health, will increase demand for industrial air emissions controls, automotive emission controls and alternative fuels. The utility is very concerned about this situation and has committed itself to install low NOx burners on many Ontario facilities which will mitigate, and decrease, the volume of smog precursors. Additionally they will also make the facilities more energy efficient.

The current supply and demand-side surveys carried out for this Study provided some insight into the factors which influence the purchasing decisions of industry for various air pollution prevention and control products and services.

- There are significant divergences between the views of domestic buyers of air pollution prevention and control goods and services, and Ontario supply companies, regarding what factors most influence air goods/services purchases.

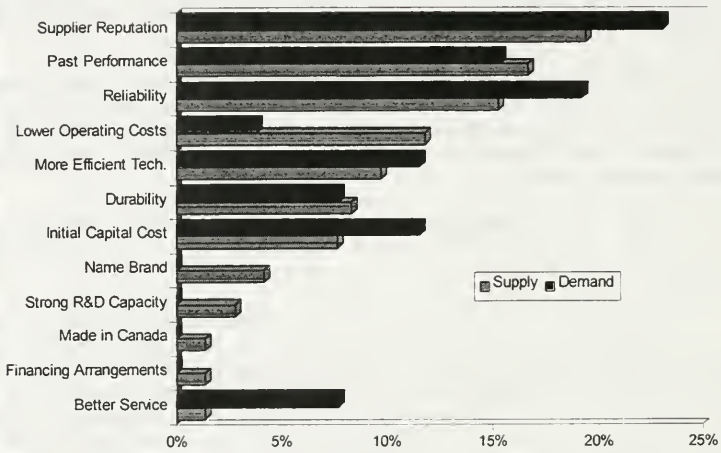
- Buyers tended to rank a number of factors as being key to a purchasing decision. These included: reputation; past performance; reliability low operating costs; efficiency; durability and initial capital outlay.

- Suppliers, generally, appeared to believe that the factors identified did not have as much influence as buyers thought. In addition, it appears as if suppliers were somewhat less sure of the factors which were considered in purchasing decisions of their customers. Of the factors suppliers rated as important: reputation, past performance and reliability ranked highly. The others were significantly lower.

- Of importance is the wide difference between suppliers and buyers in their assessment of the importance of low operating costs - buyers felt this was much more important the suppliers.

In essence, this part of the surveys suggest that Ontario air companies need to be reputable and have delivered good performance in the past to be considered by buyers, but the successful contract bidder's product or service must also be price competitive and efficient to successfully obtain business.

Chart 5
Top Factors Influencing Air Technology Purchases



Source: Supply-Side Survey, MOE Air Study, 1998
Note: Name Brand, Strong R&D Capacity, Made in Canada and Financing Responses not Applicable to Supply-Side Companies

2.4.3 US Markets

For a number of market factors the US is the largest air market in the world. US markets are high relevance to Ontario air companies for two obvious reasons. Firstly, US air companies are the primary foreign competitors exporting air pollution equipment and technologies into Ontario. While no empirical market data exists which tracks the percentage of exports from the US versus other countries which import into Ontario, a conservative estimate of 70% does not appear to be out of line (it is likely close to 85%) given close Canada-US trading relationships and the air supply strength of the US economy. Secondly, as noted earlier, Ontario air companies are active exporters into the US.

Air market forces in the US include the following.

- ***US Regulatory Activity:*** For the last 20 years, US air pollution regulatory activity has led the world, and in many cases, established global standards.

- ***Particulates:*** In July 1997, the EPA introduced new monitoring requirements for particulates to support revisions to the National Ambient Air Quality Standards for particulate matter and fine particulates. The monitoring system will be critical in determining the sources, volumes and location of PM 2.5 above allowable standards. Opportunities exist for companies with innovative and cost-effective particulate monitoring technologies. Implicitly, the EPA is coming to the conclusion that it will likely have to start from "ground zero" in building a new monitoring infrastructure *(Source: EPA Website, Office of Air Quality Planning and Standards).*

- ***Ground-Level Ozone:*** In October, 1997, the EPA asked 22 US states to submit implementation plans that address the regional transportation of ground-level ozone. Affected states include: Pennsylvania, New York, Michigan, New Jersey, Illinois, Missouri, Ohio and Virginia. A prime factor behind the direction was concern over transport of ground-level ozone between states. This factor, clearly, is also of relevance to Ontario. This creates yet another market driver to address automotive and industrial emissions, notably in the Great Lakes region *(Source: EPA Website, Office of Air Quality Planning and Standards).*

- ***VOCs:*** The EPA has proposed cutting emissions of VOC from architectural coatings by up to 106 000 tons annually. *(Source: EM, August 1996, EPA proposes cuts in emissions form paints and coatings).*

The prevalence of air market studies in the US are an ideal source of market intelligence for Canadian companies (contact Canadian consulate in interested area). Some recent reports which have become available include:

- "Air Pollution Control in Southern California: Regulations, Technologies and Market Opportunities", Canadian Consulate General, Los Angeles.

- "Business Opportunities for Canadian Firms in Environmental Upgrades at US Pacific Northwest Pulp and Paper Facilities", Canadian Consulate General Seattle.

- "Market for Environmental Hazardous Waste, Solid Waste and Air Products and Services in New York and Pennsylvania: A Guide for Canadian Exporters", Canadian Consulate General, Buffalo.

- "Clean Air for Michigan" and "Controlling Toxic Air Pollution in Michigan". Contact the Michigan DEQ at 517-373-7023.
  Source: DFAIT, 1997.

Another key facet of US market is the breakdown of air product and service demand by industry sector as illustrated in Table 7. Market penetration and marketing strategies are often most effective when tailored to specific industry sectors.

Table 7
1997 US Industry Breakdown of US Air Product Demand
($US millions)

Industry	Particulate Scrubber	Absorber	Adsorber	Biofilter	Dry Scrubber	Other	Total
Food Processing	4.58	13.74	3.43	4.58	0.00	0.00	**26.33**
Forest Products	13.48	56.18	1.12	1.12	0.00	0.00	**71.90**
Chemical & Petro Chemical	13.74	137.38	28.62	2.29	4.58	9.16	**195.77**
Metal Finishing	50.37	100.74	9.16	2.29	8.01	5.72	**176.29**
Surface Coating	11.45	11.45	125.93	1.14	0.00	11.45	**161.42**
Electronics	5.33	39.96	13.32	0.00	4.00	1.33	**63.94**
Municipal Wastewater	13.74	68.69	11.45	11.45	0.00	2.29	**107.62**
Waste Combustio	0.00	13.50	11.90	0.00	81.00	0.00	**106.40**
Other	36.63	57.24	34.34	2.29	11.45	9.16	**151.11**
Total	**149.32**	**498.88**	**239.27**	**25.16**	**109.04**	**39.11**	**1060.78**

Source: The McIlvaine Company, 1997

- The "Big Three" industrial air markets in the US are Chemical and Petro-Chemical, Metal Finishing and Surface Coatings. In all cases, Ontario supply capacity in these sectors is strong, reflecting business activity in the province's automotive parts and assembly, white goods and wider manufacturing sector.

- There is a high concentration of product demand in the North East US where many traditional manufacturing industries have historically located most of their operations. While this concentration is declining over time (with companies moving operations to the South and Midwest), the North East region is still the most fertile market for air products and services.

- The Food Processing and Forest Products sectors, while relatively smaller in scale, represent areas where Ontario firms have a strong track record, and due to price advantages (related to exchange rates) may be able to be competitive against domestic US suppliers.

Source: The McIlvaine Company, 1997

2.4.4 European Markets

Air markets of other industrialized countries are more challenging for Ontario air companies to sell into than the US, due to European competitions, European Focussed Financing and difficulty maintaining European market presence. Nevertheless, some of these markets offer export market opportunities for niche technologies or services, and shed more light on global air market trends and developments.

- ***Germany:*** Major growth in German air markets occurred with reunification. However, investment in systems for the former East Germany are expected to be mostly complete by 1998. German demand for environmental improvements, and continued acute public interest in air quality, will lead to demand for niche applications in industry *(Source: Frost and Sullivan: Forecasts of the German Air Pollution Control Equipment Market. In European Air Pollution Control Equipment Markets. 1995).*

- ***United Kingdom:*** The UK air market is sluggish due to variable enforcement and planned closures of major coal-fired power stations. In essence, the UK has been able to make air quality improvements over the past decade as it has weaned itself off coal thermal power. Further, unlike many other industrialized nations, the UK has been less enthusiastic in seeking out technological solutions for vehicle-generated smog *(Source: Patrick Stratton, Canadian High Commission, London, 1996).*

- ***Czech Republic:*** Since separation from Slovakia three years ago, the Czech Republic has sought to improve air quality in urban centres and industrial regions. The US Department of Commerce estimates the air pollution market to total US $321 million in 1997, and growing at a rate of 7% a year. Good market opportunities exist in the power sector, and energy conservation in industry *(Source: US DOE, 1997).*

- ***Poland:*** Similar to the Czech Republic and other central European countries, Poland's economic transformation is driving air pollution markets. Expenditures are estimated at US $300 million, with imports accounting (largely for equipment) for 40% of the market. Demand is high for desuphurization devices, high-temperature dust collectors and air quality measuring equipment *(Source: US DOE, 1997).*

- ***Turkey:*** With a foot in both the European and Middle Eastern economic spheres, Turkey has a large economic base which has been experiencing a boom for over a decade. The country's environmental industry grew by some 120% between 1992 and 1996 due to public and industrial demand for pollution prevention and control. The air pollution market is modest at US $87 million , though growing at a rate of 22% a year. Turkey's cities suffer from severe air pollution caused by coal-based heating systems, vehicle exhaust and industrial emissions. While Italy currently supplies 32% of Turkey's air pollution equipment market, growth and unmet needs provides niche opportunities for Canadian firms *(Source: US DOE, 1997).*

- ***European Union:*** The importance of EU to continental environmental markets cannot be overstated. The regulatory and fiscal powers of the Union make it a force to drive air markets in a number of respects. Firstly, the EU sets environmental quality standards that are, or will, become mandatory for all member countries. Secondly, the EU has a range of programs which promote the commercialization and diffusion of environmental technology. For example, its current Science and Technology program (running over a five year period) has an allocation of US $27 billion, of which 8% has been allocated to environmental initiatives. Thirdly, the environmental action of the EU is particularly affected by the "green" ethic of countries like Germany and the Netherlands. All told, the EU forces are growing European air markets, and are promoting technology competition from continental air companies *(Source: Environment Watch: Western Europe, Vol. 5, No 5.).*

While the European market appears promising (largely because of the growth and liberalization of emerging economies in central and eastern Europe), market penetration will be difficult for Ontario air companies for a number of reasons.

1. ***Competition:*** Severe competition from EU air pollution products/services companies which enjoy geographic proximity, and lower prices to preferential tariff positions.

2. ***Financing:*** Europe-focused financing programs, either through the EU, or the European Bank for Reconstruction and Development (EBRD: the regional World Bank agency).

3. ***Market Presence:*** The complexity and cost of establishing, and maintaining, a market presence in a market that on one hand is increasingly unified (through the EU) and, on the other hand, continues to be frustratingly fragmented due to factors such as language and buying patterns of purchasers.

2.4.5 Emerging Economies

The major emerging, or developing, market of Latin America and Asia are profiled below.

Central and Latin America Markets

The Environmental Business Journal estimates the air pollution control market to be $US 7.8 billion in 1995 *(Source: EBJ, Vol. XI, October/November 1995).* EBJ has been pointing to rapid expansion of Latin American environmental markets over the 1990s and has concluded that economic growth, liberalization and the improvement in public fiscal amounts (though not in all countries) is creating a climate which will drive both regulatory and voluntary actions over both the short and long term.

This view has been endorsed by the Commission for Environmental Cooperation (CEC), the NAFTA environmental agency in its 1996 report entitled: "Assessing Latin American Markets for North American Environmental Goods and Services". The CEC pointed to the "top five" environmental priorities in major Latin American countries, as illustrated in Table 8.

Table 8

Latin American Air Pollution Priorities

Country	Air Pollution Priorities
Colombia	Air Pollution Mitigation
Venezuela	Hydrocarbon Air Pollution
Brazil	Industrial and Power Emissions
Chile	Automotive Pollution Santiago
Argentina	SO_2, PM-10 Control

Source: Commission for Environmental Cooperation, 1996

Illustrations of Latin American market activity follows:

- ***Chilean Market:*** The Chilean market for air pollution and control monitoring equipment is projected to reach $4 billion over the next 5-8 years. Air pollution is most seriously a problem in Santiago which is considered the third most polluted city in Latin America after Mexico City and Sao Paulo. Main pollution sources are: diesel motors, industry, natural dust, residential wood heating, and agricultural burning. Primary target markets for Ontario companies include: catalytic converters, combustion control and reduction/control of minerals processing air emissions.

- ***Brazilian Market:*** Air pollution is a serious environmental concern in Brazil. Public pressure has led the government to introduce stricter industrial emissions regulations (e.g. for industrial parks), though the enforcement continues to be lax. Key market opportunities include:

  - Textile Air Filters Capable of 175 degrees Celsius,
  - Air Quality Monitoring Systems,
  - Air Testing and Monitoring Equipment,
  - Air/Gas Filters of Particulates and SO_2,
  - Catalytic Converters for Diesel, Natural Gas & Alcohol Vehicles,
  - Multi-Purpose Electrostatic Precipitators.

  Source: Potential Brazilian Market for Canadian Products and Services in the Environmental Protection Field, Canadian Consulate General, Sao Paulo, 1992

Two other commercial points on the Brazilian market are warranted.

1. Brazil ranks 5th in successful implementation of projects with Canada, with a total of 57 projects.

2. Double Taxation Treaty with Brazil is in place with Canada to avoid double taxation.

Box 4

Ontario Success Stories

- ***APPC Exports to Mexico:*** An example of Ontario air export activity to Latin America is the APPC Filtration Inc., based in Hamilton at the Greater Hamilton Technology Centre. APPC's domestic market includes Dofasco, which uses their filter products to reduce air emissions from its coke ovens and blast furnaces. APPC has aggressively targeted Mexico for export, focusing on the high amounts of smog pollution in Mexico City. The company has recently signed a million-dollar deal to control air emissions in a Mexican factory *(Source: Hamilton Spectator, February 16, 1998).*

- ***The Colombian SOLAM Initiative:*** With the support of Environment Canada's International Environmental Management Initiative (IEMI), a group of Canadian companies have formed a consortium (the SOLAM Group of Canada: Cleghorn & Associates; Conor Pacific Environmental Technologies; Maxxam Analytics; Senes Consultants; and Lupien Rosenberg [Columbia]) to provide environmental solutions to improve Colombia's air quality. Decades of pollution have taken their toll in Colombia. A key focus of the initiative is the Sogamoso valley, north of Bogota, which is one of the most industrialized parts of the country. The SOLAM Group will offer a range of air management and technology services to Colombia to seize market share for Canadian companies.

South and Southeast Asian Markets

Recent economic downturns aside, Asian air markets are large, growing and represent both broad-based and niche market opportunities for Ontario's air pollution prevention and control sub-sector. Burgeoning industrial growth, increasing urbanization and improved living standards (at least on a long term trend basis) are creating debilitating air pollution problems, not only in Asia's 140 cities above 2 million population, but also in the country-side due to the air dispersal patterns.

Some overall market information:

- ***Cost Power Expansion:*** Many coal fired power plants are being built in Asia - 60% of the electrostatic precipitators will be placed in Asia (1995) and 61% of the flue gas desuphurization systems ordered for 1996 for Asian utilities.

- ***Waste Incineration:*** Given power supply requirements, Asian countries are looking to develop waste incineration potential. This will drive demand for various air pollution equipment *(EM January 1996. Robert McIlvaine: Global Outlook for Air and Waste Markets).*

- ***Regional Market Activity:*** Environmental Business International (EBI), of San Diego, California estimates total revenues in Asia from air pollution Control (APPC) equipment and services at nearly $US 5.7 billion in 1995, up from slightly over $US 5 billion in 1994. The Environmental Business Journal's (EBJ's) country breakdown of this estimate is found in Table 9.

Table 9

APPC Equipment Revenues in Asia (US $ in millions)	
Country	**Revenue 1995**
Japan	3, 300
South Korea	900
Taiwan	800
Hong Kong	90
Singapore	80
Thailand	100
Indonesia	50
Malaysia	30
Philippines	20
China	300
India	200
Other	100
Total	5, 670

Source: EBJ, 1996

It is also interesting to note the following Asian Air Pollution Equipment Orders as a percentage of the world total as provided by McIlvaine and Company (January 1996).

- Electrostatic Precipitators: 60%
- Scrubber and Adsorbers 27%
- FGD Systems 61%
- Fabric Filters 25%
- Bags 18%

Some country by country highlights.

- ***South Korea:*** Public concern has prompted the government to invest in environmentally friendly technologies especially with regards to APPC and water treatment. There are opportunities for Canadian companies which specialize in vehicle emission control, clean room technologies and pollution monitoring/management. *(Canada Export, Special Issue, March 1997).*

  South Korea is among the most active markets for both utility boilers and APPC systems followed by Taiwan. The biggest surge in recent demand has occurred for flue gas desuphurization equipment and electrostatic precipitators for new power plants and heavy industries *(WME Volume 7 issue 2. April 1997).*

  In 1995, Canada and Korea signed an MOU for environmental protection. An Agreement of Cooperation now exists between the Canadian Environmental Industry Association (CEIA) and the Korean Pollution Control Association. The MOU is a mechanism through which Ontario companies can penetrate the Korean market. *(Market Report - Korea Environmental Industry. Ottawa: Department of Foreign Affairs and International Trade. 1996).*

- ***India:*** The Indian air marketplace mirrors general Asian trends, though, there tends to be greater interest to address industrial air emissions rather other forms of air pollution. A 1996 market report on India's environmental markets prepared by The Delphi Group for a Team Canada mission, estimated APPC demand to be US $ 650 million, rising at a rate of 20-25% annually. Major air pollution problems include:

  Fly Ash;

  Desuphurization;

  Particulates;

  Vehicle Emissions; and

  Industrial Emissions in Major Industries (e.g. cement, petro-chemicals, steel, thermal power, etc.).

  Perhaps uniquely among emerging economies, Indian courts have, over the past three years, rigorously applied air pollution regulations. Over 125 separate judgments have forced closure of industries which were non-compliant in terms of air quality standards. In most instances, these judgments forced multiple businesses (i.e. between 20 - 300) to close. *(Source: DFAIT. December 1997. Environmental Sector in India).*

- ***China:*** Air pollution is one of China's most enduring pollution problems. According to Sofres Consulting Asia Pacific, the air pollution market is the largest market segment after water, and between 1994 and 1995, imports of air pollution equipment increased by 44%. While appears promising, and the Chinese government is devoting greater resource to environmental protection, pollution abatement is not a high priority at the provincial and municipal level (and these governments dictate most of the economic and environmental priorities). This said, priorities identified include:

  Flue Gas Desuphurization;

  Vehicle Emissions;

  SO_2 Control;

  General Stack Control Technologies;

  Fly Ash;

  Airborne Toxins (e.g. mercury, cyanide, arsenic); and

  Carbon Abatement.

  (Source: The Air Pollution Control Market in China. Ottawa: Department of Foreign Affairs And International Trade, Trade Commissioner Service, 1996).

- ***Philippines:*** Metro Manila is considered to have one of the highest levels of air pollution in the world. As a result, the Philippine government is requiring all polluting industries to install pollution control equipment. The level of commitment to enforce new regulations is another thing altogether. The cement, metal foundries, petroleum refineries and power sectors must comply with air legislation which is driving demand for air products and services *(Source: Market Report - Philippines: Environmental Industry, DFAIT, 1997).*

- ***Thailand:*** Recent economic troubles have diminished the Thai government's fiscal ability to address air pollution problems. As the baath (the Thai currency) recovers, the government hopes to re-commit itself to a range of air pollution initiatives including the following:

  Two-Stroke Engine Conversion and Emissions Control;

  Gas Desuphurization;

  Stack Emissions; and

  Acid Emissions.

  (Source: Market Report - Thailand: Environmental Industry, DFAIT, 1997).

- ***Taiwan:*** The Taiwanese government has demonstrated leadership on environmental issues, including air pollution. The country also, arguably, has the strongest economic position in Asia. As a consequence, Taiwan has been aggressive in taking regulatory measures to control emissions, and has usually dedicated public resources to ensure targets are met. Major air management initiatives include:

  Charges to Industry Exceeding Air Regulation Standards;

  Emissions Management Systems on an Airshed Basis;

  Control Measures for Hazardous Air Pollutants;

  Vehicle Permit Systems;

  Development of Low Emission Technologies;

  Enhanced Odour Control Measures; and

  Efforts at Commercializing Cleaner Fuels.

  The above management initiatives have led to specific industry and source air pollution prevention and control programs/directives. In effect, these measures have changed the competitive environmental business Taiwan must operate in and unleashed demand for industry and transport focused air pollution prevention and control products and services.

  Of all Asian countries, Taiwan has an air market that most closely reflects the US (and in most respects, goes beyond Canadian domestic air pollution control efforts). Regular, transparent emissions monitoring systems show that results are being achieved. While Taiwan has done much, more needs to be done. The country is, therefore, a prime market for Ontario air companies since the government and industries are continually seeking for better air management, abatement and prevention management systems and technologies *(Source: Dr. Leon Tzou, Director Science and Technology Centre, Taipei, 1998).*

Box 5

Ontario Success Story

RWDI, the Guelph-based air consulting services and modeling firm, has been able to successfully penetrate the Taiwan market through the establishment of a number of relationships with the country's regulatory authorities and major private companies. RWDI took the time, and made the investment, necessary to garner a reputation for quality air services in the Taiwanese market.

Asian air markets are almost too big too ignore. But their very size, distance from Canada and transactional challenges with exporting to them should give Ontario air companies the incentive to think hard before jumping in. Niche, or country specific, strategies will generally prove much more fruitful than broad-based marketing.

2.5 Who's Buying Ontario's Products

2.5.1 By Industry Sector

Within Canada, the following industry breakdown emerged from both the demand-side survey, and consultations with industry associations during the preparation of this report. It should be noted that buyers were not able to supply data noting what were their percentages of Ontario or Canadian versus offshore suppliers of air products and services. Below is a summary of industry by industry demand for air products and services.

Table 10

Demand for APCC Product and Services by Sector

Sector	1997 Percentage of Purchases
Chemicals	9%
Petro-Chemicals	14%
Energy	17%
Automotive	24%
Pulp & Paper	9%
Ferrous and Non-Ferrous Metals	12%
Others	15%
Totals	100%

Source: Demand-Side Survey & Consultations, 1998

Various industry associations were consulted to determine their appraisal of demands for air pollution products and services. Their input follows:

- ***Canadian Electricity Association & Power Utilities***
  - Short term concerns are the management of NOx and SOx. Currently coal plants use electrostatic precipitators (ESPs), low NOx burners and operating controls and procedures for NOx reduction, flue gas conditioning and scrubbers.
  - Particulates (PM 2.5, and PM 10) are an emerging issue. The industry is concerned about how it will meet (and the cost of meeting) proposed regulations which in draft form are three times more restrictive than in the US.
  - Heavy metals, such as cadmium, mercury are gaining prominence. The CEA is not sure where the federal government will go on contaminants such as mercury, and the technology to remove this substance is very costly.
  - GHG reduction is obviously the big issue given the high promotion of thermal power in Ontario, Alberta, and other provinces. It should be noted that some air pollution technologies (e.g., scrubbers) actually increase the amount of CO_2 produced because of energy requirements.

- Strategically, as power plants age, power utilities will not look to high cost technological fixes but, rather, will invest in other fuel options to replace coal including: gas turbines/combined cycle, medium to large-scale co-generation plants and fuel cell gasification plants.

❑ *Mining Association of Canada*

- Key air issues are: emissions from smelters, SOx and toxic particulates from metals production (not related to size).
- Climate change not a big priority as industry has been improving energy efficiency approximately 1% a year.
- In the long term the industry will be moving away from pyrometallurgy to hydrometallurgy which will address many air emission problems.

❑ **Canadian Pulp and Paper Association**

- Most important air issues: climate change, particulates (2.5 and 10) and odour control (total reduced sulphur).
- The industry also needs to look into reduction of NOx and VOCs.

❑ **Canadian Petroleum Products Institute**

- The reduction of NOx and VOCs to support the implementation of the smog plan are number one priorities.
- Acid rain re-emerging as an air issue.
- Gasoline reformulation is an issue, including the reduction of benzene and sulphur in gasoline.

❑ **Canadian Chemical Producers Association (CCPA)**

- Major watch on endocrine modulators (e.g. dioxins) and their potential impacts.
- Toxic management, especially benzene, is a high priority issue that companies are addressing. The industry recently signed an MOU with federal government regarding benzene emissions.
- CCPA members have a number of projects in place to reduce NOx and VOC, and other smog gases.
- On Climate Change companies have flexibility to adopt voluntary measures to reduce emissions to 70% by 2001 based on 1994 levels. The targeted goal is to reduce projected 13% growth in greenhouse gas emissions by the year 2000, based on 1990 amounts, to 8% growth.

- **Canadian Motor Vehicle Association**

  - Major issues are smog, climate change, particulate matter (as related to the CCME NOx and VOC plan), HCFCs in vehicles, and CFCs in manufacturing equipment.
  - Methane and N_2O and hydrocarbons from vehicle tailpipes is an issue under review.
  - Odour issue is a factor which may arise in the future if new paint formulations are used. The biggest source of air emissions is from painting operations, namely, VOCs from solvent usage.
  - Companies are dealing with them in different ways (e.g. new application technologies, new formulations, powder coatings of paint). Companies like Chrysler are looking for a technology solution for a high efficiency paint spray booth (they need particulate overspray - PM 2.5 and 10 - reduced)
  - There is an MOU on Pollution Prevention signed between EC and MOE named the Automobile Manufacturers Pollution Prevention Project. It promotes application of advanced air technologies.

- **Transportation Sector**

  - Toronto Transit Commission (TTC) has been very involved in natural gas initiatives. About half the vehicles now ordered in North America are gas powered.
  - One company has a beta test site and is the standard test equipment supplier for the Clean Air Emissions program
  - The TTC gas tested their whole fleet with smoke meters, and identified action plans for buses that require attention, but which are still compliant.

Box 6

Ontario Success Story

GFI Control Systems of Kitchener Ontario has been an active player in fuel switching and conversions of fleets. The company manufacturers electronic fuel management systems for natural gas and propane bi-fuel vehicles. GFI has assisted the TTC make vehicle conversions to gas powered fuels reducing air emissions and improving energy efficiency.

General findings from consultations with industry and industry associations (see Appendix E), and the demand-side survey, include the following.

1. Companies anticipate an increase in spending on monitoring and analytical goods and services in the next 2-5 years.

2. Hydrocarbons and VOCs are of concern across the board currently and in the long-term (issue of greatest concern).

3. There is a strong industry-specific dimension to air market drivers.

4. Potential and current regulations, and voluntary agreements, continue to be the major drivers for actual purchases of APPC equipment and services.

5. Employee health is an issue in most surveyed companies in the chemical, autoparts and pulp & paper sectors.

6. Total cradle-to-grave costs (i.e. combination of initial capital and operational efficiency) are of prime importance to the purchasing decision. Other key factors include reliability of product and the supplier's reputation for good performance.

7. Buying decisions are most often made by a committee or group of people, or recommended by the project engineer for the specific issues/project.

8. Startlingly, no company surveyed had any plans to invest in, or purchase, any new Canadian air technology. In part this was because some were not aware of any technology developments. Addressing the lack of awareness on the part of industry buyers represents a major opportunity to increase demand for Ontario air technologies. Leveraging this opportunity will be addressed in Section V of this report.

9. Top sources of information on technologies were trade magazines, industry shows and associations, and sales people .

2.6 Non-Traditional Areas of Air Pollution Prevention & Control

Over the past 15 years, both national governments and corporate executives have had to re-think and re-examine many of the fundamental issues associated with the escape of pollutants to the ambient air or upper atmosphere and their impact on the planet. Rachel Carson's book, *Silent Spring*, and Gro Brundtland's 1989 report to the United Nations on the concept of *Sustainable Development* all played a role in this paradigm shift in thinking among decision-makers. This shift was from one based on the belief that "science" was the answer to all problems and that the planet was an inexhaustible "sink" for all our waste to one based on the need to recover, re-use and recycle resources as well as control and prevent the escape of hazardous emissions.

This shift in thinking led to many interesting developments, most notably the Rio Earth Summit in 1992 and the Agenda 21 resolutions. Even before the Summit, steps had been taken under the terms of the Montreal Protocol to eliminate the use of certain ozone depleting substances over a strict timetable. Part of the debate surrounding the continued use of ozone depleting substances such as CFC 11 and 12 was related to their use as refrigerants in heat exchangers for ventilation systems to maintain acceptable indoor air quality.

The combination of the Montreal Protocol requirements and ambient air quality issues related to bacteria, such as the one attributed to causing *Legionnaire's disease*, as well as harmful VOCs in airtight offices caused by solvent "bleed" from new carpets have led to the development of a strong demand for better controls and a thriving industry in the heating, ventilation and air conditioning *(HVAC)* sub-sector.

In addition, health-related legislation, strongly driven by the Workplace Hazards Management Information System (WHMIS) has also led to increased controls regarding worker exposure to ambient air hazards in operating plants.

The 1980s energy crisis resulting from actions taken by the OPEC countries also signaled the requirement for the developed countries to become less dependent on fossil fuels. By the early 1990s, there was a growing realization that global warming resulting from mankind's activities could be leading to potentially dramatic consequences to many parts of the planet. The paradigm shift in this case was the realization that it was not only necessary to reduce fossil fuel use, but sustainable practices had to be adopted through the development and use of renewable energy sources and improved energy recovery, wherever possible.

Much of the thinking associated with these energy issues now form the basis of the Kyoto Climate Change agreement and, like indoor air quality, offer tremendous opportunities for air prevention and control companies who are concerned with finding integrated or innovative solutions to replace the traditional *end-of-pipe* solutions.

2.6.1 Indoor Air Quality (IAQ) Market Definition

Indoor air quality markets are growing rapidly and represent an area of competitive advantage for Ontario companies. At the heart of the indoor air market is the simple fact that industrial, institutional and residential buildings and facilities, both in industrialized and emerging economies, generally have poorer air quality than that found at the street level. Poor indoor air quality is a risk to health, and reduces the standard of living for many people.

Key areas covered under this heading are:

- Heating,
- Ventilation,
- Air-Conditioning,

- Humidifiers/De-Humidifiers,
- Air Filtration,
- Inspection, Monitoring and Control,

2.6.1.1 IAQ Export Activity

An estimate of global exports of indoor air quality (IAQ) products and services, respectively by Ontario and Canadian companies is provided in Table 11. Note the growth projections made for each market segment.

Table 11

Global Exports for Indoor Air Quality Goods & Services ($Cdn millions)

Segment	Ontario		Canada	
	Estimated 1996 Revenues	Annual Growth Rate (1992-1996)	Estimated 1996 Revenues	Annual Growth Rate (1992-1996)
Heating	7	3%	25	28%
Ventilation	177	54%	297	66%
Air-conditioning	98	0%	133	4%
Humidifiers / de-humidifiers	12 (estimated)	50%	20	50%
Air filtration	6 (estimated)	20%	10	20%
Inspection, monitoring and control	91	52%	99	48%
Total	**385**	-	**584**	-

Source: Cullbridge Marketing & Communications, 1997

Note: As mentioned previously, one should interpret IAQ figures with some caution since the majority of the market is a direct, or indirect, function of construction activity. In the above table, for example, only the humidifier/de-humidifier, air filtration and inspection, monitoring and control segments represent non-construction based activity.

Canada exported about $584 million worth of IAQ products and services in 1996, two-thirds of which ($385 million) originated from Ontario. The ventilation, air filtration, humidification and de-humidification, and gas detection segments all have been growing by at least 20% a year. As one would expect, the United States is the largest export market for Ontario and Canadian IAQ products & services. Related imports were valued at $5 billion in 1994, and were growing at about 9% per year. Demand for related Canadian products has been growing at over 10% a year, for specific segments and countries *(Source: Cullbridge Marketing and Communications, 1997).*

2.6.1.2 IAQ Industry Structure and Economic Impact

The Canadian IAQ supply capacity is fragmented with over 50% of companies with fewer than 25 employees. Only about a quarter of companies in the sector have more than 50 employees. Markets have been volatile. For example, American Sensors, the Toronto-based star of the gas detection segment, recently went bankrupt. On the other hand, a British Columbia firm is now the largest Canadian exporter of such products, but much of its manufacturing has been contracted to an Ontario supplier. There is no reason to suggest that market volatility will abate in the near term. After year 2000 the market can be expected to settle down with dominant firms emerging. There is thus a short term market "window" for Ontario companies to try to obtain market share and penetration.

A number of successful Canadian companies in this environmental industry sector have recently been purchased by foreign firms. VenMar/Vanee was acquired by the Broan Group, which is owned by a US parent, Nortek. Bionaire was purchased by US-based Rival. Engineering Dynamics was purchased by its American distributor. Except for the case with Bionaire/Rival, the Canadian companies have maintained production. These developments are a clear indication of market consolidation in light of volatility. The IAQ markets provide important dividends for the Ontario and Canadian economies.

1. ***Increased Worker Productivity:*** The US EPA estimated in 1989 that reduced indoor air pollution could save the USA annually about $5 billion in productivity losses associated with major illnesses, and as much as $60 billion in productivity losses on the job and increased leave time *(Source: University of Berkley, IAQ Study, 1998).*

2. ***Energy Efficiency and Climate Change:*** About 20% of Canada's total energy consumption is used for heating and cooling the air in our homes and offices. Heating and air conditioning systems that are more energy efficient must therefore play a significant role in any serious and comprehensive attempt to reduce CO2 production and global warming *(Source: Natural Resources Canada, 1997).*

3. ***Health Impacts:*** Perhaps most importantly, reduced health costs. The US EPA estimated in 1989 that indoor air pollution was responsible in the USA each year for about $1 billion in medical costs for major illnesses. No corresponding figure is available for the Canadian market, however, given similarities in housing and commercial stock in the two countries one would expect health impacts to be comparable.

2.7 How Do Ontario Firms Measure Up - Strengths & Weaknesses

2.7.1 Technology Innovation

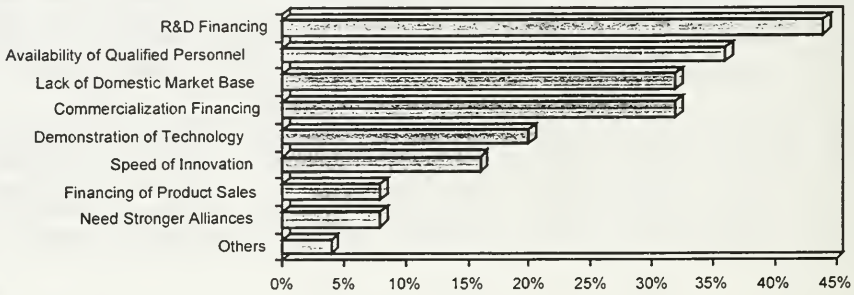
Of Ontario air companies surveyed, only two firms said they did not conduct Research and Development. Of the others:

- 71% (17) of those conducting R&D indicated that they do greater than 50% (generally over 80%) of it with in-house technical staff, and 59% of these (10) do 100% in-house.
- 14 (58%) conduct some of their R&D in conjunction with a partner.

The distribution of responses regarding identified barriers to technology research and development, and commercialization are illustrated in Chart 6.

Chart 6

Barriers to R&D and Commercialization.



A number of interpretations can be made from the above responses to the supply side survey.

- There is a divergence of technology expenditures among Ontario air companies. In part this may be a consequence of a blend or emerging versus mature technologies, and a product/service split.
- Expenditures of total revenue allocated to R&D varied significantly from 0% (3 firms) to 60% (1 company). The sector average was 10% of total revenue, with a median 3.75%. These figures are average for a technology sector, and are, in fact, higher in percentage of revenue terms than most environmental industry market segments.

- In terms of financing of Technology R&D and commercialization, Ontario firms made three key points. Firstly, 44% of the responding companies indicated that R&D financing was a barrier to the firm's R&D and commercialization efforts. Secondly, 37% of firms believe that a lack of availability of qualified staff was an obstacle to technology development. Thirdly, 32% of companies also said that the lack of a market base was more of an impediment to their growth than other factors identified in the survey.

2.7.2 Industry Output and Trade Balance

From the Ontario supply-side survey:

- Gross annual revenues for 18 of the responding companies ranged between $100,000 and $250 million. The average was $32.6 million, however, the median was $7 million which may be more meaningful in describing the revenue of most Ontario air companies.

- Net profits ranged between a loss of ($200,000) and a profit of $15.8 million. Average net profit was $2 million and the median was $0.59 million.

- Shareholder equity ranged from -$0.8 million to $46.5 million. The average was $10.3 million, and the median $1 million.

2.7.3 Export Orientation

The marketing budgets of Ontario air companies show a clear commitment to export development.

- Ten firms noted that up to 10% of their total revenue was earmarked for both domestic and foreign marketing activities. One half of responding companies allocated between 3% and 5% of their revenues to each of these areas.

- Generally, one third of companies who responded spent an equal amount of money on both domestic and foreign marketing. Another third showed a greater focus on foreign marketing, and the remaining one third indicated an emphasis on domestic marketing.

Air companies vary in making approaches to governments to penetrate export markets and technology development. Eight firms responding (31%) indicated that they had received financial support from one or more of the following agencies: CIDA, PEMD, IRAP, NRCan (cost-share research) and Technology Partnership Canada. CIDA was by far the most popular form of funding as five firms received money through this organization ($77,000 to $124,000), while only 1 firm received money from each of the other agencies.

A further 12 companies indicated that they had received no funding from CIDA, PEMD or any other organization (whether they had actually applied for support was unclear), and 6 respondents left this question blank.

2.7.4 Investment in Plant and Equipment

No clear pattern emerged regarding investments in plants and equipment in Ontario's air sector. Most companies chose not to make any comment on this item during supply-side interviews and interactions.

Given that plant and equipment investment primarily relates to air pollution equipment manufacturing some non-substantiated observations can be made. Firstly, the air equipment manufacturing sector does not appear to be expanding capacity. Secondly, it may well be that the focus of investment is on niche technologies which may not require major plant infrastructure. Thirdly, manufacturers importing products to Ontario, notably from the US, continue to maintain their dominant position in terms of supplying air pollution equipment to Ontario industry.

2.7.5 Employment

A breakdown of employment in the air sector of Canada's environment industry, as supplied by Statistics Canada, is illustrated in Table 12 below.

Table 12

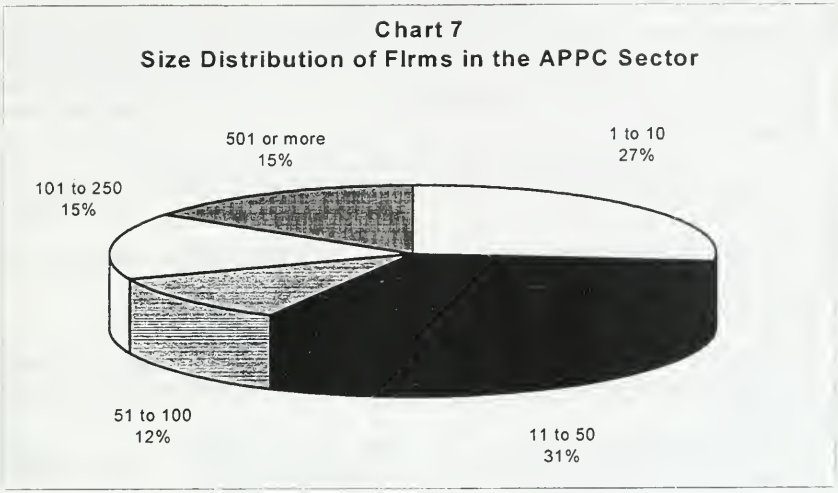
Employment in the Air Sector of Canada's Environment Industry

Employment Category	Business Sales	Business Own Account	Government	Total Employment
Product Employment	657	-	-	**657**
Services Employment	425	3823	-	**4248**
Total	**1082**	**3823**		**4905**

Source: Statistics Canada 1995 Environmental Industry Survey

From the above Statistics Canada data, Canadian air pollution prevention and control companies employed a total of 4,905 people. This is likely an underestimation because the data does not include the transport-related emissions prevention and control segment.

Of the Ontario air companies surveyed, the distribution of employment, by number of employees per firm, is provided in Chart 7.



2.7.6 Overall Competitiveness

Ontario air companies generally tend to rank their competitiveness highly, though, they tended not to do this in terms of the competition, but in general product/service advantages.

- 14 of 26 firms noted four or more advantages of their products/services.
- 8 firms indicated their product had no disadvantages, and an additional 9 only checked one disadvantage.
- Principal advantages were perceived to be effectiveness of technology and demonstrated performance (15 checks), followed by operating efficiency of technology, price and superior service (12, 11, 10 responses respectively).
- Principal disadvantages were price (9), followed by available government assistance (7; note 4 indicated this to be an advantage), and rapid availability of product (4).
- No one marked operating efficiency, technology servicing capacity & upgrades, effectiveness of technology, or life span of product as a disadvantage.
- No apparent correlation between size, function, funding, or exporting activities and advantages/disadvantages selected.

Winning bids and securing contracts is, arguably, one of the most accurate tests of competitiveness. In this respect, Ontario companies provided the following reasons for the success or failure.

- 57% of respondents (15) indicated 4 or more reasons why they won their last contract. But of these only 2 firms checked 3 reasons why they lost a recent contract. The remaining companies checked zero, one or two reasons

- Price/operational costs appeared to be a winning factor for 73% of the firms in winning their most recent contract. Given that a number of Ontario firms also noted a lack of price competitiveness in a earlier survey question, suggests that some firms are price competitive and some are not, or there is variation in such competitiveness by contract or over time.

- Demonstrated performance was part of the winning combination for 65% of the respondents.

- Current relationships assisted in winning recent contracts for 54% of companies.

- Superior technology was cited in 46% of cases as a reason for success.

- By far the most quoted reason for losing a most recent contract was price and/or capital cost/operational cost of project - 80% of respondents indicated one or more of these reasons.

- 27% (7) respondents did not check any disadvantages (or possibly do not understand why they lost their most recent contract)

Based on the above, a number of conclusions can be noted. Ontario air companies believe they compete effectively in terms of technology and services quality (though were silent on the life cycle operating efficiency of goods/services). The demand side survey bears this out. However, the sector appears markedly weaker in price competitive terms.

2.8 Summary of Market Demand and Activity

Table 13 provides a summary of domestic and global market activity and demand drivers. The summary is a synopsis of Section II which contains an extensive amount of information on air prevention and control markets.

Table 13

Summary of Domestic Market Activity Demand Drivers		
Market	**Current Activity**	**Major Demand Drivers**
Ontario	• Mature Market • Activity on Monitoring & Measurement • Power Market NOx & VOC • Fuel Conversion Opportunities through eventual trichloroethane elimination	• New Demand Emerging for Control of Automotive Emissions • Climate Change Solution Demand on the Horizon • Suphur in Fuel Control Potential • Smog Plan may Drive Demand
Rest of Canada	• Some of SCF Reduction Activities • Selected Opportunities in Control of Ozone Precursors • VOC Protocol and Industry Activity • West Coast Air Quality Standards • CCME Smog Initiative	• Fine Particulate Control Soon Required • Linkage between air Quality and Health • Implementation of Kyoto Convention • Greater Pollution Prevention and Process Technology Focus.

A summary of major export markets and demand drivers is provided in Table 14.

Table 14

Summary of Global Market Activity & Market Overview		
Market	**Current Activity**	**Major Demand Drivers**
United States	• Monitoring Requirements for fine particulates • Ground Level Ozone Reduction • Continued Demand for Air Products in Major Industry Sectors • Technology Incentives to Promote Air Sector R&D	• Linkages between air quality & health • EPA regulations regarding non-attainment states (e.g. north east US) • Stricter Engine Controls – 4 stroke • Implementations of Kyoto Convention • VOC Control • "New" Growing Measures in the US South east and South west • Pollution Prevention
European Markets	• Industrial transformation in Central Europe to control NOx, SOx, and VOCs • Urban Air Management Plans • Incentives for air technology R&D • Emerging EU Air Standards • Capital Allowances for Clean Air Technology	• Expansion of EU Standards into Central Europe • Implementation of Kyoto Convention • Product Re-Design and LCA to Reduce Air Emissions • Convenants and Incentives to Reduce Air Emissions.
Emerging Markets	• Hydrocarbon Destruction • Automotive Catalytic & Fuel Improvements • SO_2 Reduction • Fly Ash • Air Quality Modeling & Monitoring • Adsorber/Scrubbers • Electrostatic Precipitators • FGD Systems.	• Fine Particulate Control • Systems to Plan Control of Air Emissions • Air Management Systems • Fine Particulates • Flue Gas Desuphurization (FGD) • Airborne Toxins.

III. Ontario's Air Pollution Industry & Public Policy

3.1 Economic Benefits

3.1.1 Gross Domestic Product (GDP) Contributions

The following calculations were used to determine the GDP contribution of Ontario's air pollution prevention and control sub-sector.

1. ***Base Data:*** From the 1995 Statistics Canada environmental industry survey, domestic and export activity for Canadian air companies totals $617 million ($533 for domestic demand and $84 in export sales). *Note, this does not include imports of products, equipment and material of $914 million.*

2. ***Adding-Up to Account for Underestimation:*** As noted earlier, the Statistics Canada figures understate likely market activity because transport-related emissions activity is not included. In addition, as a first-time survey, the initial survey has likely failed to capture the comprehensive scale of market activity. For example, other Statistics Canada first-time surveys tended to underestimate market activity by 25-35%. Therefore, The Delphi Group believes that a more accurate figure for air market activity in Canada on domestic account would be:

Base Estimate:	$ 617 million
Add: Base Underestimation of 25%	$ 154 million
Add: Transport-Related Activity (from Delphi report for TPC)	$ 600 million
Estimated 1995 Canadian Air Pollution Market	**$ 1,371 million**

3. Translating this Canada-wide figure to the Ontario market can, give the current availability of national accounts data, be done on a proxy basis. The KPMG/Cleghorn Study of 1994, stated that 53% of Canadian air companies operated in Ontario. The KPMG Study also concluded that the larger companies in the sector were, largely, located in Ontario. *For the purpose of estimating Ontario activity in the sector it is recommended that calculations use an estimate of 60% of total air market supply activity being based in Ontario.*

Estimated Canadian Air Pollution Market	$ 1,371 million
Estimated 1995 Ontario Air Pollution Market (at 60% of Canadian Market)	**$ 823 million**

3.1.2 Worker Productivity

The Statistics Canada environmental industry survey found that air companies in Canada employed 4,905 people (this does not include the transport-related air emissions segment). To estimate worker productivity, the following calculations are made.

- Taking the estimate provided by Statistics Canada (point 2, Section 3.1.1) that air industry activity totals $617 million.
- Dividing the Statistics Canada figure by the employment level ($ 617 million/4905), you arrive at an estimate of worker productivity of $125,790 per worker, per annum.
- This figure is comparable to average Canadian worker productivity, but is significantly less than for other high technology sectors. What this suggests is that the sector, as noted earlier, is a blend of general air services and air technology companies.

3.1.3 Total Economic Impacts

To make an estimate of total economic impact of the air pollution prevention and control sub-sector on the province of Ontario, the following calculations were made.

- The Ontario Ministry of Finance uses a prudent approach to estimating broader economic-wide impacts of activity in any specific business sector.
- The direct multiplier utilized by the Ministry of Finance is 1.3 times the actual or estimated business activity.
- Applying this to the market estimate of $ 823 million, and using the Ministry of Finance direct multiplier, overall economic impact on the province's economy from the APPC and prevention sector is:

  $ 823 million x 1.3 = $ 1,070 million

Thus, the market estimate of total economic impact of Ontario's air pollution supply sector, for both domestic and export markets, is $1,070 million.

3.1.4 Total Employment Impacts

It is also of value to make an estimate of total employment in the sector, and the overall job impact on the province's economy.

- Worker productivity as estimated by Statistics Canada is $125,790 per worker.
- Estimated domestic air sector activity is $ 823 million which translates into total employment of 6,543 ($823/$125,790) in Ontario air companies and business-own-account for corporations based in the province.
- On a multiplier basis this translates into a overall provincial direct impact of 8,505 full time equivalent jobs.

3.2 Environmental and Health Advantages

3.2.1 Indoor & Outdoor Air Quality

Simply put, poor air quality is a human health risk, especially to vulnerable groups such as the elderly, and to individuals with respiratory weakness. Poor air quality is also insidious, it is generally long term exposure to air-borne pollution which gradually impacts upon respiratory and other systems until the point is reached when a rapid decline in health status is experienced. Even more disturbing is the fact that most of the potential health impacts of air pollution are debilitating and full recovery is rare. Not only is this situation tragic from a human standpoint, it also represents an enormous cost to society.

The public understands these risks all too well. The 1997 World Environmental Monitor published by Environics International measured public opinion on sustainable development issues. The Monitor found, in all 24 countries surveyed, that the one environmental issue ranked more important above all others (by no less than 94% of people surveyed in each country) was the impact of pollutants on human health. In this respect, the health of children was felt to be particularly at risk *(Source: Environmental Monitor, Environics International, 1997).*

The Ontario Ministry of the Environment, based on an analysis of hospital emissions, has estimated that 1,800 Ontarians die prematurely as a result of airborne contaminants, primarily smog-related emissions. These types of health effects were among the important factors which led the Ontario government, through the Ministry of the Environment (and voluntary industry), to develop the provincial Smog Plan and Accord. The Smog Accord states:

> *"..We recognize that: Reducing smog can improve human health, reduce health care costs and improve the quality of the environment ... To achieve success, everyone - individuals, businesses, governments and non-governmental organizations - must be part of the smog reduction effort."*
>
> *Ontario's Smog Plan: A Partnership for Collective Action, 1998*

It is also incumbent to point to the health risks arising from poor indoor air quality. As noted earlier, the range of indoor air emissions, and poor ventilation, can combine to make indoor air quality worse than most outdoor environments. The accumulation of air toxins in homes and workplaces appear to increase the risk of illnesses such as emphysema, asthma and chronic respiratory illness *(Source: The Lung Association, 1997).*

The improvement of outdoor (notably urban) and indoor air quality thus has a "triple bottom line".

1. The *quality of the environment is improved.*

2. *Social benefits are achieved.* For example, fewer mortalities would occur and provincial health care costs are reduced (e.g. an estimated reduction of 45% of NOx and VOCs would result in 189 fewer mortalities a year, 190 fewer cardiac arrests and respiratory hospital admissions and 6,200 fewer emergency room visits for asthma, and between 3-4 million fewer episodes of acute respiratory symptoms than in the base case scenario). *(Source: Ontario's Smog Plan: A Partnership for Collective Action, 1998).*

3. *Economic benefits are achieved.* For example, Ontario would not lose those additional years of productive activity which individuals in the prime of working life (respiratory illnesses tend to strike experienced workers during, or approaching, the last third of their working careers), a period when they are the most productive.

3.2.2 Total Reduced Emissions

Arriving at a figure for total reduced emissions for the province as a result of activity in the air pollution prevention and control sub-sector is daunting. Diverse as the sub-sector is, no aggregate source of data exists to make a estimate of total contribution to reduced emissions Ontario air pollution companies make. Some proxy data, and means of estimation would therefore, have to be employed.

The major contributing factors to reduced provincial outdoor emissions are identified as:

- Thermal Energy Emissions,
- Industrial Combustion Emissions,
- Coatings, Finishing and Solvents, and
- Transport-Related Emissions.

There is no currently available breakdown, by type of emission, by industry sector or source.

3.3 The Need for Skilled Labour

The air pollution prevention and control supply-wide survey found that 36% (9) of responding companies noted that the availability of qualified personnel was a barrier to corporate development and sales growth.

Interviews with companies identified the following labour requirements which were not sufficiently being met.

- Air Technology Specialists (by Specific Industry).
- Multi-Disciplinary (i.e. can work on several air product platforms) Air Pollution Technicians and Technologists.
- Marketing Experts.
- Experienced (and not highly priced) Project Managers.
- Dual Technology Platform Expertise (e.g. catalytic converters, natural gas engines).

The labour "gap" is clearly is an obstacle to technology R&D. In part, this seems to be a function of normal business operations of "finding the right person for the right job". There also appears to be a price factor. That is, the expertise exists in Ontario, but air pollution companies may not be able to afford talented personnel due to industry price competitiveness.

Labour issues that appear to be a factor which should be addressed include the following.

- Technical and university-based education which blends the development of core competencies with business development, marketing and administration.
- Promotion of cross-sectoral transfer of technologists, product developers in the various air markets and techniques to promote greater literacy about new "blended" technologies.

IV. Market Forces - Where Is the Industry Heading

4.1 Drivers of Future Growth

A number of forces appear to be driving the growth of domestic and global air markets. These include demands for:

- Control of Key Toxic Emissions;
- Addressing Climate Change and Reducing GHG Emissions;
- Domestic Regulatory and Voluntary Forces;
- Domestic Customer Demand Preference;
- Pollution Prevention and Process Controls; and
- Air Quality Measurement and Monitoring.

4.1.1 Control of Key Toxic Emissions

Ontario air companies affirmed the market view that a number of environmental issues will drive air markets and lead to new and different demand conditions, notably, climate change, toxic gases, odour and vapour control, and particulate control.

- Over the next 3 years there is a definite shift as greenhouse gases received the most number 1 votes (7) followed by toxic gases (4) and PM 2.5 (3)

- GHG also received the most top 3 votes (11) followed by PM 2.5 (10) and then odour & vapour control (8)

4.1.2 Addressing Climate Change and Reducing GHG Emissions

The importance of efforts to combat Climate Change, and GHG emissions cannot be understated. The Kyoto Protocol is leading fossil fuel consuming companies to examine their risk exposure in the national and global marketplace. The interrelationship between fossil fuel consumption, air pollutants and GHG emissions is profound. Deal with one problem, you tend to deal with the others, and for this reason action on climate change will produce benefits in terms of improved air quality.

The specific types of Climate Change drivers include the following:

- Search for non-fossil fuel based energy including small hydro, biomass, wind and solar power.

- Technologies which neutralize GHG in the process of addressing air emissions including NOx and VOCs (e.g. Thermal Energy International).

- Technologies which facilitate the use of alternative fuels in specific situations, or from certain sources (e.g. Yugotech's natural gas conversion, Iogen's ethanol production which uses enzymes to break down cellulose of materials such as wood waste and straw).

- More efficient combusting and catalytic technologies for fossil fuels (e.g. Engineering Control System's catalytic converters for large machinery that operate in underground environments in the mining industry).

In essence, the Climate Change factor will be an enormous driver for more efficient and innovative air emissions prevention and control technologies. This is arguably the most significant market driver for air markets over the next decade.

4.1.3 Domestic Regulatory and Voluntary Forces

A number of points from this study's surveys highlight the impact domestic regulatory and voluntary forces.

- Primary acid gases was ranked by six demand-side firms as the primary "current" air pollution concern for Canadian industry; second was toxic gases, hydrocarbons & VOCs, odour & vapour control with 3.

- Looking at the top three priorities - PM 10 received the most votes (12), followed by hydrocarbons & VOCs (10), and then toxic gases, GHGs, and primary acid gases (8). There was also a high expectation of fine particulate regulations, in both supply and demand markets, within two years.

- It is difficult to see a connection between type of concern listed and sectors serviced because many of the companies service a number of sectors and many of these sectors generate a broad range of pollutants.

4.1.4 Customer Preferences and Demands

Similar to the demand-side survey, 'reputation for good performance', 'past company performance', and 'reliability' received the most "top 3" votes from supply companies as to the factors that their customers are emphasizing in their technology purchasing decisions. 'Lower operating cost' was next.

But an interesting point was the fact that, more suppliers ranked 'more operationally efficient technologies' as the number 1 factor (total of 5); company performance receive 4 #1 votes from suppliers.

4.1.5 Pollution Prevention and Process Controls

The drive for air emission control, especially, in industrialized countries is clearly moving up the pipe into industrial processes where efforts are being made to prevent pollution. As major industrial corporations seek to reduce the cost of compliance the focus is on reducing emissions within the plant, or integrated into zero or low emission technologies. In effect, this represents process re-design which, over the past two decades, has been one of the major reasons for productivity increases in Canada and other industrial countries.
This movement leads to demand for new, non-conventional technologies which may not even be viewed as air emission solutions in and of themselves but, rather, part of the overall drive to process efficiency. This will lead to demand for new air pollution products.

Demand factors for pollution prevention and process control include the following.

- cost reduction for air emissions compliance
- eco-efficiency benefits including improved productivity
- internalizing cost within the plant
- corporate image benefits of seen as preventing pollution.

4.1.6 Air Quality Measurement, Instrumentation and Monitoring

Part of the drive in air markets is to measure just how dirty or clean air is - either in a particular airshed, local emissions point or over a large geographic area. Of particular concern is the specific composition of substances and their concentrations in particular air mass. This need for information is driving the air quality measurement, instrumentation and monitoring market segment.

Market drivers are increasing demand for the following technologies.

- real time, automatic measurement systems
- effectiveness of measuring substances at low concentrations
- dynamic, spatial displays of air quality in an airshed
- mobile, point source monitoring systems.

4.2 Projected Market Growth and Development

4.2.1 Global Projections

McIlvaine and Company's projections for the air pollution prevention and control sub-sector are generally bullish in global terms. They see constant and significant growth in most market segments. For example, projections for the large scrubber and adsorber market are provided in Table 15.

Table 15
Scrubber & Adsorber Markets
Projected Growth Rates ($US millions)

Year	Particulate Scrubber	Absorber	Adsorber	Biofilter	Dry Scrubber	Other	**Total**
1996	549	1,890	830	94	163	140	**3,586**
1997	594	1,990	906	101	193	152	**3,936**
1998	643	2,171	976	110	213	165	**4,280**
1999	699	2,354	1,057	118	226	179	**4,635**
2000	757	2,546	1,142	128	238	193	**5,006**
2001	820	2,763	1,236	138	255	210	**5,425**
Growth Rate to 2001	**49.3%**	**52.7%**	**48.9%**	**68.1%**	**56.4%**	**50.0%**	**51.2%**

Source: The McIlvaine Company, 1997

4.2.2 Export Targeting of Ontario Air Companies

Ontario air pollution prevention and control companies appear to pinning their future success largely on export growth.

- Two thirds of respondents (11 of 18) indicated that their percentage of total sales originating outside of the country will increase over the next three years, while the remaining one third indicated equally that exports, as a percentage of total sales, would remain constant or decrease.

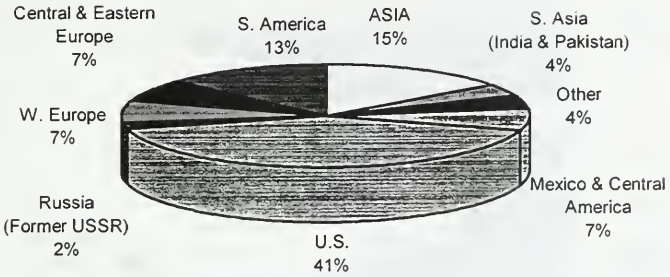
- Of the 22 Ontario air companies which export equipment and services, 14 considered the US to be their largest source of "export" sales, 4 indicated Asia, and the remaining noted Europe, Central America, or a combination of two or more of the previously noted areas.

- Companies projected export growth in both existing export markets and new economies being targeted. Some companies expected growth in countries in which they already had a presence, though, some indicated declines. And ten companies indicated that they would be entering new countries, however, there was no trend towards one particular market or another.

The US was by far the first priority for export markets of Ontario air pollution companies. Three quarters of the responding companies ranked the US as the number one export market.

In getting a balanced picture of export plans it is valuable to go beyond priority one rankings since companies generally focus on a few foreign markets, rather than just the first choice. As illustration, the second choice for export markets was Asia and South America which were ranked first, second or third by 46% and 41% of the participating firms, respectively. Weighting export market targeting (priority 1: valued at 3, priority 2: valued at 2, priority 3: valued at 1), one arrives at Chart 8 below.

Chart 8
Targeted Export Markets

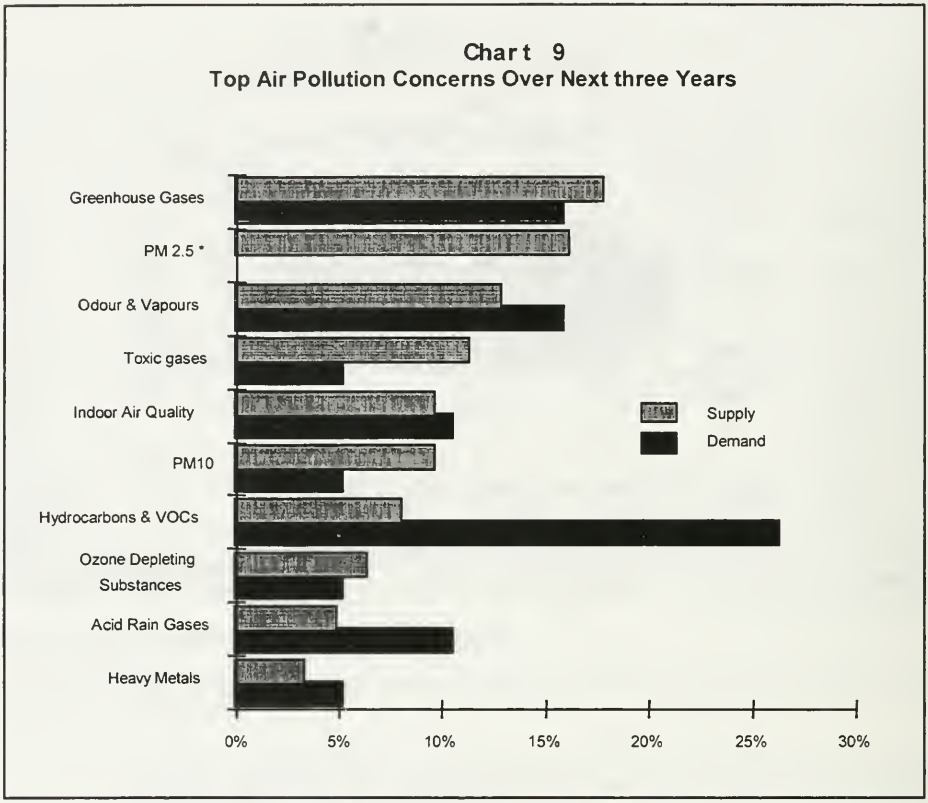


Source: Supply and Demand Side Surveys, MOE Air Study, 1998

Simply put, the US is clearly the primary target of Ontario air companies, however, it is important to note that the Americas and Asian Countries are significant export targets based on the weighted ranking.

4.2.3 Canada & Ontario

All Ontario air companies surveyed stated that they projected positive growth in demand for their products and/or services over the next three years. Seventy percent indicated growth of greater than 10%, while the remaining 30% were more conservative estimating growth of between 5% and 10%.



** PM 2.5 was not ranked as a priority issue by any of the demand-side survey participants*
Source: Supply and Demand Side Surveys, MOE Air Study, 1998

Some of the issues that may influence demand for air pollution prevention and control technologies are illustrated in Chart 9. Some points on this chart include

- There was a close correlation between responding supply and demand companies in terms of the assessment of top air pollution concerns over the next three years. Greenhouse gases and odour and vapour control was ranked highly by both the supply and demand sides of the market.

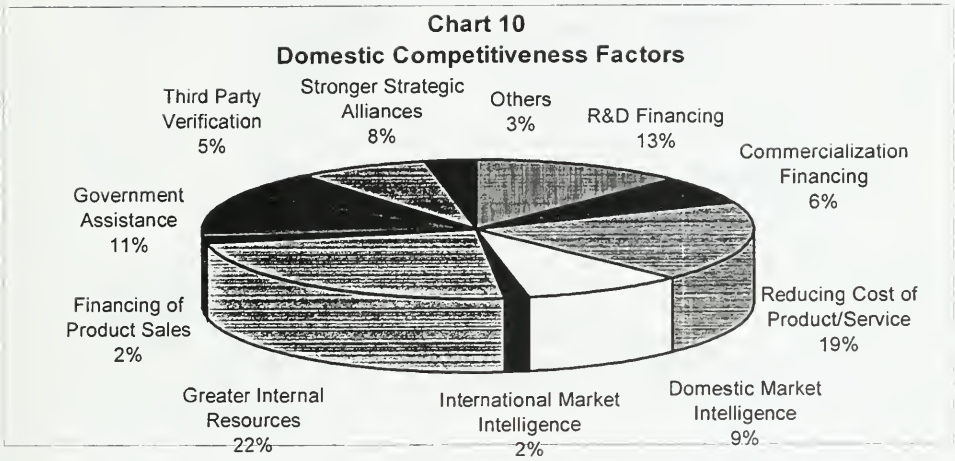
- There were two notable exceptions in terms of assessment. Supply companies felt that buyers would not be very concerned about hydrocarbons and VOCs, however, buyers indicated that this issue was of significant concern. Suppliers also felt that PM 2.5 would be an issue of concern to buyers, however, not one demand-side participant ranked PM 2.5 as an emerging issue of concern.

- There also appeared to be more concern among buyers, than suppliers, for the control of acid rain gases.

4.2.4 Domestic and Export Competitiveness of Ontario Companies

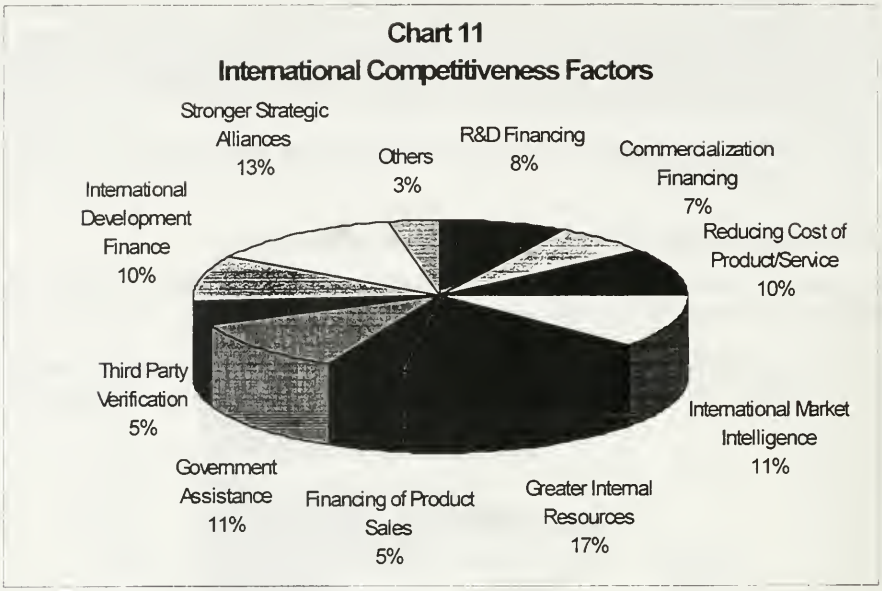
When asked to rank the three top measures these firms believe would enhance their competitiveness, Ontario air companies said the following.

- Reducing the cost of the product or service received the most number 1 rankings for domestic and international markets, as depicted in Chart 10.



Source: Supply and Demand Side Surveys, MOE Air Study, 1998

- Looking at total top three rankings for international competitiveness - greater internal resources again received the most votes (10), followed by stronger strategic alliances (8), government assistance (7), market intelligence (7), and reducing cost of product/service (6)



Source: Supply and Demand Side Surveys, MOE Air Study, 1998

4.3 Strategic Planning Horizons

Over the short (i.e. to the year 2000), medium term (2001-2005) and longer term (i.e. 2006 and beyond) different market conditions are at play in domestic and export air markets. These forces and factor should influence market strategy.

Table 16 provides a general appraisal of the forces that will likely be in play over the short, medium and long term horizons in both industrialized and emerging markets. The forces noted are ones which are expected to receive higher priority, at different points in time, from governments and private industry.

Table 16

Air Market Forces & Opportunities: Short, Medium & Long Term

Time Horizon	Markets	
	Industrialized	Emerging
Short Term to 2000	• PM 10 Control • PM 2.5 Control • VOC Control • SO_x Control • Reduce Ozone Depletion	• PM 10 Control • VOC Control • SO_x Control • Particle Reduction • CFC Reduction
Medium Term 2001-2005	• GHG Emission Reduction • IAQ Products • Carbon Compound Reduction • PM 2.5 Control • PM 10 Control	• PM 2.5 Control • CFC Reduction • Reduce Ozone Depletion • Carbon Compound Reduction
Long Term 2006 and Beyond	• GHG Emission Reduction • IAQ Products • PM 2.5 Control • Carbon Compound Reduction	• GHG Emission Reduction • PM 2.5 Control • Reduce Ozone Depletion • Odour & Vapour Control

Source: The Delphi Group, 1998

A word of caution. Overall industrialized and emerging market projections are guides, conditions will vary greatly by country and industry sector. The general trends are of value, however, in getting a sense of the magnitude of market demand for certain types of markets. For example, the lessening importance of addressing CFCs in industrialized countries does not mean a market does not exist, rather, other markets are emerging as more important or dominant. The overall strategic planning horizons are useful in pointing to opportunities for investment, product/service development and demand conditions to pursue in specific markets.

4.4 Potential Threats to the Air Pollution Industry

Global air markets are volatile. Market demand ebbs and flows, and competition is both a day-to-day and a strategic reality. In this business climate, Ontario's air pollution prevention and control sub-sector will be subjected to a number of commercial threats. Some of these threats pertain to the existing business of Ontario companies, and other are competitive threats to business expansion.

On the first count, the threats to core business are identified as follows.

- ***Industry Consolidation and Cost Competitiveness:*** As noted earlier, buyers rate life cycle costs of air pollution equipment highly. This includes the cost of services during installation, and on-going service and materials requirements. The movement to environmental industry consolidation in the US, and to a lesser extent Europe, will lead to the establishment of "full-service" air companies. One advantage these companies will have is economies of scale, and the fiscal resources to undercut price of competitors. To address this threat, Ontario companies will need to become more price competitive internally, or look to alliances which allow them to maintain competitiveness.

- ***Technological Innovation:*** The air sector, like the rest of the environmental sector, is becoming more heavily weighted to capital (thus technology) versus services than in the past. While services will continue to be a larger proportion of the industry relative to capital, increasingly, technology will be the defining basis of competitive advantage. This suggests that Ontario companies need to invest more heavily in technological innovation. One example of this is Goodfellow Consultants move to establish Goodfellow Technologies as a corporate basis to purse technology innovation in the air sector. Another example of a company which has used this approach is GFI Control Systems. This appears to be sound business planning in light of competitive forces:

- ***Technology and Growth Financing:*** Related to the issue of technology is financing. The supply side surveys clearly recorded the fact the Ontario air companies believe that a lack of R&D and commercialization financing is an obstacle to realizing the potential of the market. In addition, especially from the perspective of export markets, financing for expansion is also a requirement for air companies.

  The reasons for the lack of financing are complex. For Ontario air companies key issues include: lack of appreciation from venture investors of the potential of air markets; lack of early stage risk capital; and the length of time between capital investment and the realization of returns. These issues are being effectively addressed by OCETA, and the organization is well placed to assist Ontario air companies overcome these obstacles to attracting financing.

In terms of export markets, the following threats are noted.

- ***Spheres of Influence:*** Many Ontario air companies have adopted a diversified (in terms of customers, industry sectors and geographic markets) approach to "hedge" their earnings base. In general, and notably in near-geographic (i.e. Canadian and US) markets this is a sound business strategy. Globally, it's prone to failure since even the largest companies choose to focus on one or two key export markets. Until significant market share is achieved in selected markets, and accompanied by profitability, it would be imprudent to enter new export markets.

- ***The Actual Export Market:*** Export markets may carry demand potential, but reality is another thing altogether. For example, the OCETA report on the *Ontario Environment Industry, 1997 Economic Survey*, made the projection that the revenue of Ontario environmental companies would grow by an average rate of 15.9% between 1995-2000. During the first three periods growth, in fact, has been in the 3-4% range, reflecting the difference between the "hoped for" growth versus actual growth (*Source: Statistics Canada 1995 Environmental Industry Survey, The Delphi Group*).

  Proven demand is a necessary condition, but not a sufficient condition to expect success in export markets. A number of other factors need to be considered. These include:

  - Air Market Size;
  - Market Growth Rates;
  - Legal Conditions (Ability to Enforce Contract Law);
  - Air Regulatory Framework and Enforcement;
  - Market-Oriented Corporate Decisions;
  - Ease of Importation and Tariffs;
  - Domestic and Foreign Competition;
  - Number of Demand-Side Industrial Sectors; and
  - Competitive Advantage of Canadian Air Companies.

  Source: Cleghorn & Associates, 1997

  Companies should strive to perform business analysis which conducts a hard assessment of market potential and contrasts this against their competitive position, and the likelihood of actual securing sales. In essence, this involves focusing on realistic transactions, and not exclusively on market demand or potential. This entails an assessment of the likelihood of successfully completing all aspects of a deal from sales to financing to repatriation of earnings.

V. Strategies to Enhance Ontario's Competitiveness in Air Pollution Markets

5.1 Strategic Options to Maximize Strengths of Local Firms

5 .1.1 An Overall Approach to the Market

Certain strategies have the potential to assist Ontario's air pollution prevention and control sub-sector to compete more effectively in domestic and global markets. These strategies should be multi-faceted, complementary and work as a "package" to position Ontario air companies to: increase sales; commercialize technologies; and expand into new foreign markets.

Completion of this study including, examination of an extensive amount of market, survey and experiential market intelligence, leads the Project Team to propose a number of potential strategies to the following key stakeholders, and specifically to the Ontario MOE Green Industry Office:

1. Federal government departments (e.g. Industry Canada, Environment Canada, Natural Resources Canada, National Research Council).
2. Technology development organizations (e.g. OCETA, CRESTech).
3. Industry associations (e.g. AWMA, CEIA).
4. Ontario air sector companies.

Schematic #3 represents the recommended strategies. Following the schematic is a description of each of the proposed strategies. The potential business strategies are grouped into the following categories:

1. Technology Development
2. Bridging the Buyer/Supplier "Gap"
3. Enhancing Competitiveness
4. Focusing Exports
5. Targeting Growth Markets

The Project Team has sought to try and address each one of the significant barriers that Ontario air companies face, thereby enhancing competitiveness in domestic and global markets through one or more of the strategies.

Schematic 3
Air Pollution Prevention & Control
Strategic Framework to Leverage Business Opportunities

Business Opportunities	Potential Business Strategies			
Technology Development	Obtaining Capital for R&D	Human Resource Development	Focusing on Technologies for Key Opportunities	
Bridging the Buyer / Supplier "Gap"	Technology Profiling	Human Resource Development	Understanding Purchasing Decisions	
Enhancing Competitiveness	Import Substitution	Price Down Quality Up	Investment Climate and Research Infrastructure	
Focusing Exports	An Americas Axis*	Proactive Export Strategies	Strategic Alliances and Partnerships	
Targeting Growth Markets	Solutions to Climate Change	Human Health Market	Pollution Prevention Opportunities	Hi-tech Air Pollution: Measurement & Monitoring

** Latin America, North America, and South America*
Source: The Delphi Group, MOE Air Study, 1998

5.1.2 Strategy Option #1: Obtaining Capital for R&D

Among the SMEs, there is a general lack of understanding about how to access capital for investment in R&D. Small companies are still mistrustful of Venture Capital companies and they often regard Chartered Banks in an adversarial light. Since capital for R&D is necessary for growth of the sector, a number of things should be considered to attract more capital to Ontario air companies.

1. Provide a summary of market potential, especially due to the Climate Change factor, and health drivers, for capital markets. This is done routinely by other sectors (e.g. information technology). Distribute the summary to institutional investors, brokerage firms, financial analysts and the media. Detailed market intelligence on the environment industry (and air sector) is already being disseminated to subscribing institutions through *Environmental Business Canada*; a quarterly publication published by The Delphi Group.

2. Work with key brokerage houses such as Loewen, Ondatjee McCutcheon, Scotia McCleod, Kearns Capital and CanAccord to have them introduced to Ontario air companies seeking capital, potentially through a special session on the matter. All these houses have a keen interest, and some are active, in the capital markets for environmental technologies.

3. Continue to support the work of OCETA in capital markets.

4. Work with brokering agencies in the US that profile environmental companies to investors (e.g. Environmental Capital Incorporated) to introduce more Ontario companies to venture investors south of the border. Working with a brokerage agency allows a company to gain wider exposure. These institutions work with numerous investors which are often too difficult (i.e. a lot of hard work) to approach and meet on an individual basis.

   Key Stakeholders: MOE Green Industry Office, Industry Canada, IRAP, Individual Ontario Air Companies and their Industry Associations.

5.1.3 Strategy Option #2: Attracting Skilled Personnel

Surveyed Ontario air companies expressed that a lack of skilled personnel was an obstacle to technology development. In part, as previously noted, this is a consequence of not having the capital to give experienced, skilled personnel the salary base and incentive to join a new technology company, particularly at an early stage of growth. This said, a couple of strategy options are available.

1. Develop an air, or wider environmental industries, R&D network between universities and colleges, research institutions (e.g. National Research Council, Environmental Health Network) to give Ontario companies access to the diverse resources in the province.

2. Prepare a package presentation on Ontario's air sector (or the environmental industry as a whole) highlighting the range of scientific, technical and academic programs in the province/country to attract graduates, especially Masters and Ph.D's.

3. Work with the National Research Council to link more Ontario companies with the Industrial Research Applications Program (IRAP), one of the federal government's most successful programs in bringing high caliber talent into Industry.

4. Establish a joint government-industry-University Center of Excellence devoted to R&D in air pollution prevention & control as well as climate change technological development.

   Key Stakeholders: AWMA, Canadian Council for Human Resources in the Environment Industry (CCHREI), Institute for Environmental Research, NRC, AUCC, Canadian Environmental Industries Association (Ontario)

5.1.4 Strategy Option #3: Focusing of Technologies for Key Opportunities

A number of key technology opportunities for Ontario air companies have been identified throughout the report. Examples are:

1. The growing demand for technologies to control the escape of greenhouse gas (GHG) to the atmosphere. Canada is the second highest emitter of GHG *per capita* in the world and this opportunity must rank among the highest, both for the domestic and international markets. While many of the GHG reduction strategies focus on reduced use of fossil fuels, there still remains a major need for prevention and end-of-pipe technologies to deal with this issue.

2. The adoption of $PM_{2.5}$ ambient air quality standards in the United States in the short term because of the link with adverse human health will provide another significant opportunity for Ontario firms. The proven strengths of these firms in such fields as hi-tech monitoring and analysis as well as special fabric filters for high efficiency, fine particulate removal should be strongly promoted and encouraged.

3. The global market, driven by the need to control the release of airborne heavy metals such as lead and mercury will still continue to offer major opportunities for Ontario companies. At least one Ontario-based company is a world leader in the area of continuous low level mercury monitoring and is positioning itself to develop a system for continuous, in-stack mercury monitoring for coal-fired utilities.

4. Indoor air technologies appear to be a strength of Ontario's air sector. Particularly in the area of new technologies (versus the construction driven products/services) export markets are promising in western Europe and Japan. As illustration, Engineering Dynamics, Carp Ontario, exports 40% of its state-of-the-art indoor air filters to Japan.

5. The automotive sector is an area of natural economic advantage to Ontario, an advantage which extends to the air pollution sector. The range of air technologies to control automobile emissions is a prime area for export development, especially into emerging economies.

   Key Stakeholders: Individual Ontario Air Companies, Industry Associations, Ontario Ministry of the Environment and the Green Industry Office, Canadian Environmental Industries Association (Ontario), Environment Canada (ETAD).

5.1.5 Strategy Option #4: Technology Profiling

It was startling that domestic buyers were unaware of newer air technologies that Ontario or Canadian firms had developed. Some ways to address this problem include the following (also refer to strategies 5 and 6).

1. Distribute the Ontario Environmental Directory on a complementary basis to major buyers of air products and services.

2. Work with the Environmental Technology Advancement Directorate of Environment Canada to update and distribute the national profile of air technologies.

3. Invite major air purchasers (with a concentrated event promotion program) to a CEIA Ontario WorkshopB, or the annual Environment and Energy Conference for a session of air pollution and Climate Change Technology Solutions.

   Key Stakeholders: Buyer Industry Associations, Environment Canada, ETAD, Environment Canada, CEIA (Ontario), Environment Industry Associations (e.g. AWMA)

5.1.6 Strategy Option #5: Understanding Purchasing Decisions

In a similar vein, Ontario air companies need to better understand how purchasers make decisions and what they value. To get a better insight into this world, some proposed approaches follow.

1. Attend major industry sector trade shows, not environmental events. The specific industries have unique needs which can be better obtained by attending such events.

2. Host a Purchasers/Suppliers Air Forum, perhaps at the events proposed in section 5.1.5 above.

3. Continue to support CEIA and OCETA-sponsored events such as *EBOBs* and special Technology Showcase events in conjunction with major Industry Trade Shows held in Ontario that focus on major sectors, such as transportation, chemicals and pharmaceuticals, Oil & Gas, mining and metallurgy. For example, a joint event sponsored by CEIA and the Canadian Motor Vehicles Association as part of a major Automobile & Truck Trade Fair would go a long way toward meeting this objective.

   Key Stakeholders: The Ontario Ministry of the Environment, Green Industry Office, Environment Industry Associations (e.g. CEIA Ontario, AWMA), individual Ontario Air Companies, and Other Industry Associations, such as Alliance of Manufacturers & Exports, CCPA, CVMA.

5.1.7 Strategy Option #6: Responding to Buyer Needs

Among many of the larger industries (e.g. automobile manufacturing) there is an incorrectly-held belief that Ontario-based air pollution prevention and control companies can only meet a very small fraction of their needs. Also, the Province is only now coming out of a period of recession and low growth, particularly in the raw materials and manufacturing sectors. As a result, the demand for solutions to air pollution problems has been small and is expected to grow at a slower rate than the country's overall economic growth rate in the short and medium term.

This poses a major problem for Ontario suppliers. It results in intense competition among domestic suppliers to establish market share in what is already a small market (compared to the US or Japan, for example) and it often gives foreign competition an unfair advantage *vis-a-vis* domestic suppliers.

Some of the ways to help Ontario suppliers respond better to Buyer needs are:

1. Establish a Secretariat that posts technology requirements by major industries. These could be listed by type, required target control limits, anticipated schedule for delivery and specifications. This activity would have to be coordinated with the Approvals Branch of the Ministry.

2. Encourage forms for presentations by representatives from private sector companies and Industry Associations to speak on Industry needs to deal with air pollution prevention and control as well as GHG emissions issues. This could be linked to the *CEIA-sponsored Workshops*, referred to under Strategy Option #5.

   Key Stakeholders: Green Industry Office, Ontario Ministry of the Environment, and Environment Industry Associations (CEIA).

5.1.8 Strategy Option #7: Import Substitution

The high level of air pollution equipment imports is the most significant structural weakness of Ontario's air pollution sector. In fact, on trade balance, the sector is in a negative position. This said, import substitution is not an easy proposition. Foreign equipment manufacturers are, for the most part, large, well-established companies with the geographic reach and capital base, to export equipment to many export markets. Further, most of the leading air pollution equipment manufacturing firms (in the US, Japan, Germany) have high levels of domestic demand which affords them a base of sales from which to spring to export markets.

For Ontario, import substitution needs to be niche based. The market needs to seek equipment manufacturing technologies where there is some basis of competitive strength. These might include:

- Catalytic and Non-Catalytic Systems
- Non-Thermal Plasma Treatment of VOCs
- Neural Networks for Process and Emissions Control
- Expert Control Systems such as Automated Paint Booths and Alarm Controls for Emission Control
- Gas Analyzers, Gas Sampling Probes, Discrete Analyzers for applications such as Incineration, Thermal Power, Thermal or Chemical Oxidization and Manufacturing Processes (Solvents, Paints, De-Greasers)
- Hi-Tech Monitoring and Analysis, such as LIDAR and spectroscopic techniques for remote sensing of pollutants
- NOx Control Systems.

Potential actions on import substitution include the following.

1. Address import substitution on an industry by industry basis.

2. There is an opportunity to promote the current *Price Competitiveness* of Ontario air companies to major industrial sectors (i.e. buyers/users).

3. Target individual companies for specific solutions supplied by Ontario air companies.

   Key Stakeholders: Environment Industry Associations (CEIA, AWMA) Individual Ontario Air Companies, The Ontario Ministry of the Environment, GIO and Environment Canada (ETAD).

5.1.9 Strategy Option #8: Price Down - Quality Up

As buyers noted time and again in the demand side survey, they are seeking high quality air product/service suppliers with competitive prices. This approach garners the reputation and track record that secures on-going sales. To this end, Ontario air companies might consider the following initiatives.

1. Publicize in the business media (environment and general) the successes of Ontario companies in Canada (i.e. such as those presented throughout this report). Options include mainstream publications and tailored ones such as Science and Engineering, Environmental Business Canada, and Hazwaste.

2. Have individual companies profile quality and value of their products and services.

   Key Stakeholders: Individual Ontario Air Companies, Environmental Industry Associations, The Ontario Ministry of the Environment, GIO.

5.1.10 Strategy Option #9: Investment Climate and Research Infrastructure

The underpinning for Strategy Options #1 & 2 is based on a desirable investment climate and a supportive research infrastructure. These two objectives are often diametrically opposed from a business perspective, since investors are usually seeking for a reasonably quick return and research must be based on long term returns with objectives that are not always precise. Government has to play a key role in securing both these conditions. Some of the ways are:

1. Increase foreign and domestic sector incentives for investors that support R&D work in air pollution prevention and control and GHG technologies in Ontario.

2. Offer economic incentives to air pollution prevention and control and GHG emissions control companies that invest in R&D and human resource development.

3. Promote technology opportunities in Ontario to foreign investors, while, at the same time, establishing legal safeguards against takeovers by foreign companies, particularly among the Ontario SMEs. It is assumed that the larger companies will not require these safeguards.

   Key Stakeholders: Ministry of Finance, Green Industry Office, Ministry of Trade and Commerce, Industry Canada.

5.1.11 Strategy #10: An Americas Focus

The world is a big place - where should Ontario companies focus in continental terms? While clearly there are major markets in Europe and Asia, and these should be exploited in terms of country specific or niche markets, there appear to be compelling reasons to create a prime continental target for the air sector. The Americas are the logical choice starting from the Canada-US economic relationship, and the continental free trade movement.

Potential actions include the following:

1. A major air technologies profile in future trade missions to the Americas.

2. Encourage special Showcase Events such as AMERICANA 99 and GLOBE 2000 that promote Ontario air technologies to potential US and Latin American buyers. Spin-off events that offer information on "how to" do business in these countries should be strongly supported. Liaise directly, where possible, with executing agencies in these countries (e.g. US Department of Commerce and Environmental Protection Agency).

3. Ensure Trade Officers in the US, Central and Latin America are fully aware of Ontario's environmental supply capacity.

4. Work to communicate to US buyers through Canadian diplomatic representation that the "Buy America" policy of the US Administration cannot unfairly penalize Canadian exports under NAFTA.

5. Leverage existing business with Canadian natural resources companies in Canada, and seek to work for them in export markets.

   Key Stakeholders: Industry Canada, DFAIT, Environmental Industry Associations (CEIA, AWMA), The Ontario Ministry of the Environment, and GIO.

5.1.12 Strategy Option #11: Proactive Export Strategies

This strategy option could almost be classed as: "how to get off the reliance on aid-financed export activity". Proactive export strategies are planned assessments of markets, and "matching" this with supply capacity and the resources (financial and human resources) required to convert market opportunity into business.

1. Offer market assessments of foreign markets. Provide a general guide on a) who to talk to, b) what are the "real" opportunities, c) available marketing and sales tools, d) available financing and how to get it. These are the most frequently asked questions by SMEs that are already actively exporting.

2. Have an intense 2-3 day educational program for Ontario companies seeking to go global. The session should have a concrete output - a new export strategy for participating companies.

3. Profile export successes.

   Key Stakeholders: DFAIT, Industry Canada, Ontario International Trade Corporation, The Ontario Ministry of the Environment, and GIO.

5.1.13 Strategy Option #12: Strategic Alliances and Partnerships

There is a growing realization among many Ontario companies that to do business abroad, they must position themselves to provide a wide range of products and services and to have effective foreign partners, who can "open doors" and help create opportunities that lead to sales. One of the ways of promoting this activity is to:

> Encourage and promote the formation of viable partnerships. Many models are available, particularly for federal programs, for examination to select a model that is workable and appropriate for Ontario.
>
> *Key Stakeholders: Green Industry Office, CEIA (Ontario and National), DFAIT, and Industry Canada.*

5.1.14 Strategy Option #13: Solutions to Climate Change

Given the fact Climate Change will be a major market driver, efforts should be taken to make Ontario air technologies, in fair measure, seen as the Climate Change solutions which many of them are.

1. Work collaboratively with the federal government to promote R&D incentives for air companies, and particularly companies which provide solutions to Climate Change.

2. Profile Ontario air companies to the Technology Table under the Climate Change national consultation process.

3. Profile Ontario air companies to industry seeking carbon offset credits. In fair measure, these demand side companies are already involved in the Climate Change consultation process in Canada.

   Key Stakeholders: Environment Canada, Industry Canada, NRCan, NRC, Ministry of Finance, Ministry of Commerce & Trade, Federal Climate Change Secretariat, The Ontario Ministry of the Environment, GIO, and Environmental Industry Associations.

5.1.15 Strategy Option #14: Health Oriented Markets

As noted in many sections of the report, health drivers (magnified by associated economic risks [and benefits] and public perceptions) are prevalent in air markets. This is particularly true for air technologies. There is, therefore, merit in highlighting the value of air prevention and control technologies in terms of improving air quality to preserve human and eco-system health, and provide ancillary benefits. Strategies in this area include the following.

1. Work collaboratively with the Ministry of Health to develop a policy framework which promotes clean air in the province.

2. Encourage Ontario air companies to include health benefit statements in the application of their technologies and services to industry buyers.

3. Inform the health and environment sector NGOs, particularly environment health networks (e.g. Lung Association, Pollution Probe), of the benefits of Ontario air technologies.

   Key Stakeholders: Ontario Ministry of Health, Individual Ontario Air Companies, Ministry of Labour, and GIO.

5.1.16 Strategy Option #15: Pollution Prevention Opportunities

The pollution prevention market is hard to penetrate. Technology/service solutions vary by industry, and are often hard-wired into plant operations. In addition, global markets are moving towards "integrated systems" as the solution, with the US and Europe leading the way. Ontario companies, particularly the SMEs, cannot compete "head-to-head" with foreign companies in this area. However, through strategic partnerships with US and European firms (refer to Option #12), Ontario companies can bring their hi-tech expertise and innovative "niche" technologies into integrated packages for pollution prevention. Additional efforts that may bear fruit include:

1. Profile success stories and the "triple bottom line" benefits of Ontario air technologies (e.g. Thermal Energy and Goodfellow technologies not only improve the environment by reducing pollution, they also decrease associated pollution costs and help curtail community health problems and related insurance claims). Such "triple bottom line" benefits will become more valued by buyers as the impacts of the Kyoto convention begin to bite.

2. Work with other industry associations (i.e. representing users/buyers) to identify front-of-the-pipe opportunities with pollution prevention technologies, to reduce the cost of compliance.

   Key Stakeholders: CEIA, Industry Associations representing Buyers/Users, Individual Ontario Air Companies.

5.1.17 Strategy Option #16: The Measurement & Monitoring of Air Pollution

Hi-tech air quality measurement and monitoring is a growth market world-wide, including Ontario. Some actions to promote this market segment are noted below.

1. When developing provincial policy and standards that address air pollution and air quality (e.g. Ontario Smog Plan), attempt to identify air quality solutions and technologies provided by Ontario air pollution prevention and control companies.

2. Market existing measurement and monitoring technologies to US markets through Canadian trade consulates.

   Key Stakeholders: Individual Ontario Air Companies, DFAIT, Ontario Ministry of the Environment, Canadian Advanced Technology Association (CATA), and GIO.

5.2 Potential Private Partners/Linkages for APPC Companies

In terms of partners and linkages for the Ontario air sector to increase competitiveness and domestic/export sales, the following are proposed:

- ***The Domestic Factor:*** Over the past five years, several consortia have been formed with Ontario-based companies that are directed towards securing market share internationally. Examples are the CENSOL Group, CANEQUIP and CANORA. Federal financial support was provided for the formation of these consortia, with a requirement that they be registered as corporate entities. All these consortia focus primarily on the environmental sector as a whole, with much of the emphasis on water & wastewater treatment and soil remediation. SOLAM Canada is an *ad-hoc* consortium that includes 4 Ontario-based companies. It is internally financed and is the only one that has focused exclusively on air-related issues with success in overseas sales.

- ***The US Factor:*** Over the past two years there have been a number of examples where Canadian and US environmental companies have struck alliances, or even merged, to increase competitiveness. With the exception of the transport-related emissions segment, however, few such alliances have been struck in the air pollution prevention and control market.

- ***Japanese/European Firms & NAFTA:*** A number of industry sectors have ably tapped into the interest offshore companies have in entering North America, through utilization of NAFTA. Provided that material and significant value-added is made in Canada, components of products can be imported into Canada, and exported as finished goods. The strategy merits exploration for the air sector.

5.3 Seizing Niche Market Opportunities

5.3.1 Emerging Technologies

Some emerging technologies in the air pollution prevention and control sector which require further development include:

- High-Efficiency PM 10 removal;
- Non-Thermal Plasma Destruction of VOCs (e.g. Corona Treatment of off-gases in fruit warehouse storage which eliminates ethylene and mold in the packing house);
- ALERT Control Systems (e.g. Monitoring Networks and Expert Choice for Multi-Criteria Decision-Making);
- Hi-Tech Monitoring (and analysis) Technologies such as the Brewer Spectrophmeter for Stratospheric Ozone, LIDAR (e.g. Laser Induced Radar Imaging for Long Range Monitoring), and Continuous Emission Monitor Based on Spectroscopic Techniques;
- Remote Sensing of vehicle emissions;
- Laboratory Services including Hi-Tech and Ultra-sensitive Source Testing, Air Quality Monitoring, Air Quality Assessment and Ambient Analytical Testing for Toxics. Firms active in this area include Monenco Agra, Conor Pacific (WTI), RWDI, Hatch Associates, Maxxam Analytics;
- The Development of "Neural Networks" as "Intelligent" means for process and emissions control;
- Special fabrics for high efficiency fabric filters that remove fine particulate (PM2.5 and less).

5.3.2 Unique Applications and Industry-Specific Needs

The specialty chemical producers industry must deal with a range of air emissions. Among the more problematic (some of which are toxic) are: dioxins; VOCs; suphur dioxide; nitrogen dioxides; and particulates. The industry is seeking cost competitive technological solutions which include:

- The formulation of chemical blends to reduce VOC emissions in the automotive, paint and coatings, adhesives, personal care products and other markets.
- The production of alternative technologies and products to substitute for stratospheric ozone-depleting chloro-fluorocarbons.
- Chemical, material and technological substitution to reduce the use of carcinogens and toxic metals in products.

Source: SRI Consulting Website: webmaster@sric.sri.com

Ontario's auto body shops are under pressure to address their air emissions. The operations finish 1.2 million vehicles a year, and emit an estimated 6,000 tonnes of VOCs. Autobody Shops are the second single largest source of surface coating VOC emissions in Canada. Information about auto body shops is limited given their number (2,600 in Ontario) and lack of monitoring enforcement capacity. As pressure mounts to implement the Ontario Smog Plan, this local market segment is a business target for Ontario air firms. The Los Angeles example in this respect is noteworthy. Tough VOC regulations in California spurred dramatic increases in paint gun efficiency, and prompted paint manufacturers to bring more benign products to the market *(Source: Globe and Mail, August 12, 1997).*

VI. Closing Summary

The air pollution prevention and control sub-sector is being driven by a number of major forces, and all indications are that significant increases in demand can be expected over the next decade. The most modest estimates project that the market will grow globally by a minimum of 6% per year through the first decade of the 21st century. This growth will, in fair measure, be reflected domestically in Canada and Ontario.

This study is therefore timely, since it provides a range of market supply and demand information - both benchmarking current activity and looking into the near and long term future. In addition, the broad nature of this report, particularly in terms of public policy issues points to the overall value of the air pollution sector to the province's economy and environmental health.

This study provides the Green Industry Office, Ontario Ministry of the Environment, and its industry advisory bodies with information which lays a foundation to assist in their work to help promote and advise the environmental industry (air sector) in Ontario.

The project partnership of The Delphi Group, Cleghorn and Associates, and Cullbridge Marketing and Communications has appreciated the opportunity to conduct this assignment.

Economic and Market Assessment of the Ontario Air Pollution Prevention and Control Industry

Appendices

"A" Documentation & Reference List

"B" Supply Side Survey Questionnaire

"C" Demand Side Questionnaire

"D" List of Responding Demand Side Companies

"E" List of Industry Associations Consulted

"F" Reference List of Key Websites

Appendix "A"

List of Documents & References

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Appendix "B"
Supply Side Questionnaire

PLEASE FAX RESPONSE TO THE DELPHI GROUP (613) 562-2008

An Analysis of Domestic and Export Markets For Canadian Air Pollution Prevention and Control Technologies

Survey conducted by The Delphi Group in conjunction with Cleghorn & Associates and Cullbridge Marketing & Communications for the Green Industry Office of the Ontario Ministry of the Environment

We appreciate your time assisting us with this survey. Please fill out the following questions, using approximations where necessary, and then fax your response to Michael Gerbis @ The Delphi Group (613) 562-2008. Company-specific data of a proprietary or competitive nature will not be published unless permission is granted from your firm.

A. COMPANY BACKGROUND INFORMATION

1. **Company Name** _____

2. **Respondent's Name & Title** _____

3. **Number of Employees (please check box with a ✓)**

- 1 to 10	❑	- 51 to 100	❑	- 251 to 500	❑
- 11 to 50	❑	- 101 to 250	❑	- 501+	❑

4. **What is your firm's principal business (please check ✓ more than one box if appropriate)?**
   - Monitoring/Analytical Goods and Services ❑
   - Manufacturer/Distributor of Air Pollution Control/Prevention Products and/or Equipment ❑
   - Consulting and/or Engineering Services ❑
   - Manufacturer/Distributor of Indoor Air Quality Products and/or Equipment ❑

5. **With respect to ownership, is your firm:**

   - Publicly Owned ❑ - Privately Owned ❑

   and

   - what percentage of the company is Canadian-owned _____

6. **What was your firm's 1997 financial position (provide best estimate if data not readily available)?**

   - Gross Revenue _____ - Shareholder Equity _____
   - Net Profit _____ - % of Total Revenue Utilized for R&D __
   - % of Total Revenue Utilized for domestic marketing _____; foreign marketing__

7. **Did your firm receive financial support from any of the following agencies (approx. $ value in 1997)?**

   - CIDA _____ - PEMDE _____
   - Other _____

B. SALES TRENDS AND TRANSACTIONS

8. What is the current and projected percentage of your total sales within the following markets:

	Current	Projected (*within 3 years*)
- Ontario	_____	_____
- Quebec	_____	_____
- Western Canada	_____	_____
- Atlantic Canada	_____	_____
- US	_____	_____
- Europe	_____	_____
- Southeast Asia (ASEAN)	_____	_____
- South Asia (India and Pakistan)	_____	_____
- South America	_____	_____
- Other _____	_____	_____

9. Rank your top three (3) targeted export markets, in order of priority (please number 1, 2, 3)?

- Western Europe ___
- United States ___
- South America ___
- Southeast Asia (ASEAN) ___
- Japan ___
- Central and Eastern Europe ___
- Mexico & Central America ___
- Russia/former Soviet Republics ___
- South Asia (India and Pakistan) ___
- Other ___

10. Are you partnering with organizations to compete in the international market? If yes, are they typically:

- Ontario companies ❑
- Canadian firms located outside of Ontario ❑
- Foreign companies specifically located in the country/area in which the tender originated ❑
- International firms in: Europe ❑ US ❑ Asia ❑ Other_____ ❑
- Government embassies, institutions or agencies ❑
- Academic institutions ❑

11. Who are your major customers (provide percentages if possible)?

- Iron & Steel Industry ___
- Non-Ferrous Industry ___
- Commercial Sector ___
- Oil & Gas Sector ___
- Pulp & Paper Industry ___
- Small & Medium Sized Manufacturing Firms ___
- Chemical/Petrochemical Industry ___
- Automotive/Transportation Sector ___
- General Public (i.e. Consumer Products) ___
- Government or Institution ___
- Others _____ ___

12. Generally, what do you estimate the demand reduction or growth for your prime set of products or principal services will be over the next 3 years (please check ✓)?

- Reduction of a) more than 10% ❑ b) 5-10% ❑ c) < 5% ❑
- Growth of a) more than 10% ❑ b) 5-10% ❑ c) < 5% ❑
- Even Situation ❑

13. What is the percentage of your revenue that is a result of (provide percentages)?

- Strictly Sales of Product _____
- Strictly Provision of Services _____
- Integrated Sales and Provision of both Products and Services _____

14. How are Your Products/Services Marketed and Sold to End Users?

- In-house Sales Staff ❑
- Strategic Alliances ❑
- Retail Outlets ❑
- Independent Distributors and Dealers ❑
- Independent Sales Agents ❑
- Combination of _____ ❑

15. How are Sales Transactions Typically Completed?

- Purchase Order ❑
- Repayment over Term ❑
- Combination of _____ ❑
- Project-Based Invoice Billing ❑
- Other _____ ❑

C. MARKET AND COMPETITION

16. Prioritize the top three (3) or four (4) global or regional economic, political or environmental forces that you expect to have a significant influence on demand for your technologies/services?

- Current regulations ___
- Potential regulations ___
- Current cost or projected increase in cost of energy ___
- Smog Reduction Plans/Agreements ___
- Acid Rain ___
- Climate Change Convention ___
- Meeting voluntary agreements ___
- Meeting customer demand ___
- Liability concerns ___
- Community relations/Corporate Image ___
- Employee Health issues ___
- Other _____ ___

17. Which among the following factors are your customers emphasizing in their technology purchasing decisions (please rank the top three)?

Past performance within your company ___
Cheaper priced technologies - (initial capital cost) ___
Lower operating costs of technologies ___
More operationally efficient technologies ___
Name Brand ___
Durability of product ___
Reliability of product ___
Improved sales and after-sales technical support (service) ___
Financing arrangements ___
Made in Canada ___
Reputation for good performance ___
Strong R&D capacity ___
- Other _____ ___

18. Rank what you believe to be the top three (3) air pollution concerns/interests for Canadian industry today (please place the numbers 1, 2 and 3 in each of the columns)?

	Current	Over Next 3 Years
- Toxic gases (e.g. benzene, carbon monoxide, etc.)	___	___
- Hydrocarbons & VOCs	___	___
- Primary Greenhouse Gases (i.e. CO_2, N_20, methane)	___	___
- Primary Acid Rain Gases (NOx, SOx)	___	___
- Particulate Emissions (e.g. PM 2.5 standard)	___	___
- Particulate Emissions (e.g. PM 10 standard)	___	___
- Toxic Gases (e.g. benzene, carbon monoxide)	___	___
- Heavy Metals	___	___
- Ozone Depleting Substances (e.g. CFCs)	___	___
- Indoor Air Quality	___	___
- Odour and Vapour Control	___	___
- Other/s _____	___	___

19. What are the competitive advantages and disadvantages of your products/service in export markets, or against foreign firms operating in Canada?

	Advantages	Disadvantages
- Price	❑	❑
- Rapid Availability of Product	❑	❑
- Operating Efficiency of Technology	❑	❑
- Technology Servicing Capacity & Upgrades	❑	❑
- Effectiveness of Technology	❑	❑
- Life Span of Product	❑	❑
- Demonstrated Performance	❑	❑
- Superior Service	❑	❑
- Available Government Subsidies/Assistance	❑	❑
- Other/s _____	❑	❑

20. What do you believe were the primary factors in obtaining, and <u>NOT</u> obtaining, your most recent major contracts?

	Winning	Unsuccessful
- Price	❑	❑
- Rapid Availability of Product	❑	❑
- Current Relationship with Purchaser	❑	❑
- Superior Technology	❑	❑
- Capital Cost of Technology	❑	❑
- Operational Costs Associated with Technology	❑	❑
- More Competitive/Comprehensive Service	❑	❑
- Being a Canadian Firm	❑	❑

- Life Span of Product	❑	❑
- Demonstrated Performance	❑	❑
- Other _____	❑	❑

21. Rank the three (3) top measures that you believe would enhance your firm's ability to compete domestically and internationally (please place the numbers 1, 2 and 3 in each of the columns)?

	Domestically	Internationally
- R&D Financing	___	___
- Commercialization Financing	___	___
- Reducing the Cost of Your Product/Service	___	___
- Market Intelligence on the Domestic Market	___	___
- Market Intelligence on the International Market	___	___
- Greater Internal Resources	___	___
- Financing of Product Sales (Export Credit Financing)	___	___
- Government Assisted Marketing, Tax Credits or Grants	___	___
- Verification of Technology by a Third Party (Ecologo, ETV)	___	___
- Stronger Strategic Alliances	___	___
- International Development Finance	___	___
- Other/s _____	___	___

D. Research & development activities

22. How is Research & Development Conducted by Your Firm (state approximate percentages)?

- No R&D ❑
- In-house Technical Staff _____
- Alliance with Government Agency (e.g. National Research Council) _____
- Alliance with Another Company _____
- Third Party (e.g. University) _____
- Other/s _____ _____

23. Rank the top three (3) technology R&D priorities that your company has?

- Improving a Current Technology ___
- Developing a New Product ___
- Gaining Ongoing/Additional Financing for Current R&D Projects ___
- Access to Required Expertise ___
- Establishing Partnerships for Joint R&D Projects ___
- Availability of Qualified Personnel ___
- Other/s _____ ___

24. Check which of the following issues are barriers to your R&D and commercialization efforts?

- Speed of Innovation ❑
- Need for Stronger Strategic Alliances ❑
- Commercialization Financing ❑
- Lack of Domestic Market Base ❑
- R&D Financing ❑
- Financing of Product Sales ❑
- Demonstration of Technology ❑
- Availability of Qualified Personnel ❑
- Other _____ ❑

25. Do your technologies and services help customers/clients reduce greenhouse gas emissions (CO_2, methane, NO_x, etc.)? In what manner (check applicable):

- through capture or neutralization of the greenhouse gas at the stage prior to emission ❑
- through pollution prevention technologies/services that reduce or eliminate greenhouse gases ❑
- from production or processes at the source ❑
- through energy efficiency ❑

26. If you answered yes to question #25, could you provide an estimate of the total quantity of greenhouse gases (in tonnes of emissions) that your technology/service eliminate on average:

- per installation/contract _____

or

- annually _____

E. OTHER COMMENTS (please write below)

Please fax your response to Michael Gerbis @ The Delphi Group (613) 562-2008

Appendix "C"
Demand Side Questionnaire

An Analysis of Domestic and Export Markets for Canadian Air Pollution Prevention and Control Technologies

We appreciate your time in assisting us with this survey. The following questions will guide the interview. Please feel free to use approximations where necessary. Company-specific data of a proprietary or competitive nature will not be published unless permission is granted from your firm.

Name
Company
Industry Sector
Size

A. Recent and Current Demand Trends

1. What are the 2-3 most important air issues that you are currently addressing, or anticipate addressing in the short and long-term?

	Current/ past two years	Next 2 - 3 years (2000-2002)	Long-term (2002-2010)
Toxic gases (eg benzene, carbon monoxide etc)			
Hydrocarbons & VOCs			
Primary Green House Gases (i.e.CO_2, N_20, methane)			
Primary Acid Rain Gases (e.g.NO_X, So_X)			
Particulate Matter - PM 10 std.			
Particulate Matter - PM 2.5 std.			
Heavy metals (e.g. lead)			
Ozone depleting substances (e.g. CFCs, freons)			
Indoor Air quality			
Odour and Vapour control			

2. What do you spend annually (approximately) and what do you anticipate spending (approximately) in the following categories?

Type of Expenditures	Approximate Annual Expenditure in past 2 years	Approximate Annual Expenditure for next 2 years	Approximate Annual Expenditure in next 10 years
Monitoring/Analytical goods & services			
Products/Equipment			
Consulting and engineering services			

B. PROCUREMENT DECISIONS

3. What are the 3-4 most important market and/or regulatory issues affecting your decision on capital outlay for APC and indoor air technologies?

- Current regulations ❑
- Potential regulations ❑
- Current cost or projected increase in cost of energy ❑
- Smog Reduction Plans/Agreements ❑
- Acid Rain ❑
- Climate Change Convention ❑
- Meeting voluntary agreements ❑
- Meeting customer demand ❑
- Liability concerns ❑
- Community relations/Corporate Image ❑
- Employee Health issues ❑

Other_____

4. What is the most important criteria to you when purchasing APC equipment and products and indoor air technologies? (Please check the top three)

- Past performance within your company ❑
- Cheaper priced technologies - initial capital cost) ❑
- Lower operating costs of technologies ❑
- More operationally efficient technologies ❑
- Name Brand ❑
- Durability of product ❑

- Reliability of product ❑
- Sales and technical support (service) ❑
- Financing arrangements ❑
- Made in Canada ❑
- Reputation for good performance ❑
- Strong R&D capacity ❑
- Other _____

5. What do you estimate is spent internally (gross) per year on R&D relating to air issues?
   $_____

6. Are you considering outsourcing any of the following areas of treatment to an environmental service company? If so, which ones?

- Toxic gases ❑
- Hydrocarbons & VOCs ❑
- Primary Green House Gases ❑
- Primary Acid Gases ❑
- Heavey Mtals ❑
- Particulate Matter ❑
- Ozone depleting substances ❑
- Indoor Air quality ❑
- Other _____

7. What percentage of your APC technologies and indoor air equipment/ services are addressed by:

Origin	Less than 20%	21%-49%	50-79%	More than 80%
Ontario companies				
Canadian companies (not inc. Ontario)				
American companies				
European companies				
Other				

8. Who makes the buying decisions in your company on the type of technologies and services to invest in? (Check as many as applicable)

   Professional purchaser _____
   Plant Manager _____
   Operations Manager _____
   Executive officer _____
   Environmental manager _____
   Consultant _____
   Other _____

9. Have you recently, or are you considering, investing in or purchasing a new Canadian environmental technology?

   Yes_____ No_____

Please describe:

10. Are there any air issues you have in which you are looking for a technological solution, but for which one does not exist to your knowledge? Please describe.

11. What are the top three sources of information your turn to most frequently to learn about new technologies?

    Trade magazines (Please list)

    Web sites

    Government publications

    Conferences and trade fairs

    Sales people

    Industry shows

    Industry Associations

12. Do you have access to knowledge of new Canadian or Ontario environmental technologies? Yes No

Appendix "D"
List of Responding Supply Side Companies

- Fenco Mac Laren Inc.
- TurboSonic Inc.
- Goodfellow Technologies
- Thermal Energy International Inc.
- Ambio Biofiltration Ltd.
- CEM Specialties Inc.
- Biorem Technologies Inc.
- Jacques Whitford Environmental Limited
- AGRA Earth & Environmental (AEE)
- Engine Control Systems Ltd.
- Lakes Environmental Software
- GFI Control Systems Inc.
- Maxxam Analytics Inc.
- Conor Pacific Environmental Technologies Inc.
- Optech Inc.
- Pollutech Environmental Limited
- Babcock & Wilcox Canada
- Amko Systems Inc.
- Protect Air Inc.
- Wheelabrator Canada Inc.
- RWDI
- Research Cottrell CDN Ltd.
- CMS Group Inc.
- Nett Technologies Inc.
- R. Murphy Limited
- Iogen Corp.

Appendix "E"
List of Responding Demand Side Companies

- Chrysler Corporation (Automotive Manufacturing)
- Dofasco Inc. (Iron and Steel)
- Nova Chemicals (Chemicals)
- Baxter Corp. (Health & Laboratory)
- Long Manufacturing Ltd. (Auto Parts)
- Daishowa-Maruceni International Ltd. (Pulp and Paper)
- Ontario Hydro - Lambton (Power)
- CAMI Automotive Inc. (Automotive Parts)
- Shell Canada (Petro-Chemicals)
- Guardman Products Ltd. (Paint and Solvents)

Appendix "F"
Reference List of Key Websites

- www.dfait-maeci.gc.ca/english/menu.htm
- www.epa.gov/airsweb
- www.epa.gov/oar/sect812
- www.epa.gov/ttn/oarpg/otagsip.html
- www.epa.gov/envirosense/program/regional/trade/cma-rprt.html
- www.fff.org.ancben.htm
- www.manufacturing.net/jump/11.htm
- www.frc.org/pff/clean/sect6.html
- www.ipan.com/press/97jul/2507da.htm
- strategis.ic.gc.ca/SSG/fh01643e_pr101.sgml
- www.eren.doe.gov/carbonstudy/
- www.open.door.cppa.ca
- www.cec.org
- www.tomorrow-web.com
- http://VirtualOffice.ic.gc.ca
- www.ene.gov.on.ca/envision/news/
- www.pollution.com

READER RESPONSE FORM

ECONOMIC AND MARKET ASSESSMENT
ONTARIO AIR POLLUTION AND CONTROL INDUSTRY

SEPTEMBER 1999

We value your comments. By completing this form you will help us to increase our understanding of how we can best utilize valuable resources and reduce costs.

1. Did you find the Economic and Market Assessment of value to your business or operation?

2. What part of the report did you find most useful?

3. Are there industry issues and opportunities not identified in the report? If so please identify.

4. Are there areas in the report we can improve?

5. Any other comments you wish to share?

Respondent's name/organization/address/phone number:

Please return a copy of this Form by FAX or by mail to the following address:

Ontario Ministry of the Environment
Environmental Partnerships Branch
40 St. Clair Avenue W.
12th Floor
Toronto, Ontario
M4V 1M2
TEL: (416) 314-7913
FAX: (416) 314-7919
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